THE

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## BRITISH ENGINEERING TRAINING FOR CHINESE STUDENTS.

SINCE first we advocated in these columns that the British Government should follow the example of the United States and France by signifying its willingness to forgo the sums due from China under the Boxer indemnity, much water has flowed down the Yangtsekiang, a good deal of loot, and not a little blood. Revolt and disorder have been rife in China, and such powers as have been established there from time to time have been more concerned in diverting all the funds they could seize to the purpose of internal strife than in devoting any money to education.

The latest information to hand is far from reassuring from a business point of view for the simple reason that unrest and instability seem to be the words that sum up the situation of large parts of this vast country. There are prophets who predict worse things than we have yet witnessed, fearing that China may become a second Russia, but this pessimistic view is discounted by various reports.

Experience shows it to be unwise to allow one's opinions and attitude to be changed by the latest sensational report that comes along in regard to so vast, so obscure, and so interesting a land as China. Any depressing view of the moment should be considered in conjunction with the official observations on the Chinese trade situation that appear on another page of this issue. Further, it is certainly not the view of American business men that the market is one to leave to itself because of unsettlement, for only this week have our newspapers reported a coming big American financial invasion of China, which is being organised with the co-operation of leading Chinese experts. When we dream our dreams regarding these foreign markets it is well to remember that they have eminent commercial and financial leaders and that we shall do well to adopt the co-operative policy as the Americans and the Germans are doing.

Sooner or later the land must reach a stage when the people will advance, whether along their own or along Western lines time will prove, but if we can assist such a movement, it will only be in accordance with British traditions toward China in the past.

If we discuss the disposal of the Boxer indemnity with the appearance of having primarily in mind the commercial advantage of securing to Chinese students the benefit of British ideas, it must not be imagined that we fail to see that such attitude may be misinterpreted. We are aware that those who look at the commercial side of this matter have already been subjected to criticism by those who think that in forgoing the Boxer indemnity we ought to be inspired by loftier ideas than those of self-interest. We believe, however, that whatever we do to assist China forward to her own peculiar type of development or to Western development will lead to larger international relations of the Chinese peoples with, to them, the outside world, of which we form a part. Therefore, we do not belittle the ideals of others by considering what lies within our own special province—scientific, technical, and industrial relations between China and Britain in the years that follow stabilisation. Indeed, these influences may be employed in co-operation with the efforts of the statesmen and even those of the missionary to lift hundreds of millions of Chinese to a higher level of civilisation.

In the proposals to assist young Chinese in their studies by training them in British ideas and

methods so that commercial relations would be strengthened between the two countries, one had visions of young Chinamen, who had advanced their engineering education in British drawing offices and workshops, returning to their own country, where, in co-operation with our own experts, they would play a prominent part in developing the resources of China on the most approved Western lines. To such aims the American Government directed its portion of the indemnity. A similar intention was held in France until the recent trouble over the Banque Industrielle de Chine resulted in a decision to expend the money instead on liquidating some of the bank's liabilities.

The British Government was long in making up its mind on the subject, and, during the war, its consideration was postponed and payments of the indemnity instalments were waived as a condition of China's entry into the conflict as our Ally. Since the Armistice the need for economy has been so great that it was felt impossible for the British Treasury to pass over any possible source of income. It has, however, been known for some time now that the committee over which Sir John Jordan presided was in favour of the scheme for applying the payments to the education of Chinese students, and it is gratifying to learn from Peking messages in the daily Press that the authorities there have been informed of our Government's decision.

Over ten million pounds is the sum involved, spread over 23 years. Many different organisations are ready to take a hand in arranging the expenditure, and many proposals for schools and colleges, with British instructors, are appearing in our newspapers. There is a plan to place Chinese apprentices in engineering and other works in this country, and we wish it could be adopted. It is, of course, recognised that there are difficulties—perhaps it could have a limited application. Foreign pupil courses at works could hardly include large numbers of pupils, the management might find it awkward to conduct the training of half-a-dozen different nationalities at once, and arrangements would be necessary between different works for suitable distribution; it has also been said that the labour unions would object if the shops contained more than a certain number of apprentices—but difficulties can always be found, and if other nations can find accommodation in their factories for special foreign pupils for a limited period, it ought to be possible to overcome the objections.

It was stated in the last annual report of the B.E.A.M.A. (Elec. Rev., April 7th, p. 500) that 92 "overseas" students from various parts of the world had been admitted to members' works, but very few of these, it seems, came from China. It was stated that a publication was being prepared setting forth the facilities existing in the works and the educational possibilities offering in this country for such "overseas" students.

It has been suggested that a sounder scheme would be to spend the greater portion of the money in China. Expert British instructors could be found there already; for example, one may quote the work accomplished at the Hong Kong University under Prof. Middleton Smith, but at various places in China, if the idea be found acceptable, the instruction could be developed along the same lines, and additional instructors and equipment could be sent if desired. Every good for the future is to be secured by co-operation between the two nationalities by such means. We must continue to take the long view in regard to China and shape our policy accordingly.

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**Insufficient Postage.**

It appears that the recent changes in postal rates in this country and between this country and overseas markets have led to confusion in the posting departments of some of our export trading firms. We believe that the matter only requires to be mentioned for it to be righted. We have so often felt sore when we have been made the victims of correspondents of some other lands which shall be nameless that we can enter sympathetically into the feelings of overseas correspondents who by pure inadvertence or through insufficient knowledge of junior posting assistants are subjected to the same treatment. The amount of physic may be small, but it leaves a nasty taste behind and does not impress the potential purchaser with the methods of the British house that desires to do business with him. We would not have given the matter this prominence were it not that the Department of Overseas Trade is continually receiving complaints, and that the Post Office has been moved by the frequency of errors to issue a special leaflet relating to the matter and setting forth the correct charges.

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**Combined British Exhibits at Foreign Fairs.**

It is announced that the Federation of British Industries, which is adopting the principle of the "combined exhibit" for its members' manufactures in the case of the Toronto International Exhibition, has decided to follow a similar course at two other shows. These are: the Barcelona Industries Fair, which will be held from March 17th to 28th, and the Finnish National Fair at Helsingfors, from July 1st to 6th. While it is felt that by means of the combined British effort a more prominent and more effective display may be secured than would happen with a few scattered stands, it is also conceivable that at many foreign shows, under prevailing conditions, a goodly number of manufacturers and traders would not be in evidence if the only course open to them was to have an individual exhibit. For shows that are not of long duration the principle seems to be an excellent one, and if properly carried out it should keep British names and British manufactures in evidence in foreign markets, a matter of paramount importance just now.

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**Imperial Wireless Telegraphy.**

Receiving a deputation from the Empire Press Union, with regard to the wireless service of the Empire, the Postmaster-General, Mr. Neville Chamberlain, is reported to have said that the Government had not yet reached a decision on the matter, but this would not be long delayed. As business men, they recognised that the present system could not be allowed to continue for long.

With all respect to Mr. Chamberlain, a newcomer to his office, and with full appreciation of his sincerity of purpose, we are impelled to say: "Fudge." So long as the Imperial Wireless Service remains in the hands of the Imperial Government, so long will delays and disappointments, and the handicapping of trade, and the cramping of the news service, continue. From the first we have opposed the committal of the service to the hands of a Government department, and if ever a forecast has been justified in the event, ours has been. The history of the relations of the Post Office to long-distance radio-telegraphy in this country has been one long story of hesitation, reconsideration, equivocation, evasion, and procrastination; innumerable promises have been made, but none have been fulfilled. We do not suggest that the technical staff of the Post Office is at fault; its engineers could do the work if they had the opportunity—but there is no stability of policy or purpose in the Government. It never reaches a decision, and although the present system cannot be allowed to continue, it continues.

If, ten years ago, private enterprise had been permitted to carry out an Imperial scheme, we should have led the world in radio-telegraphy; an Imperial service would have been functioning before the outbreak of war, and by this time we should have had an adequate system of wireless communication in full operation. But private enterprise must be repressed at all costs—even at the cost of depriving the Empire of a sorely-needed system of cheap and rapid intercommunication. As Mr. Robert Donald said at the interview, and as we

say—we don't care much whether we get round the Empire by one step or two steps or three steps, or by whom the system is administered, so long as we get there; he added that the smaller papers get most of their foreign news by wireless from France, Germany, the United States, and Japan!

Meanwhile the Dominions, in utter disgust, have cut short the negotiations and have decided to make their own arrangements. Oh, that we could do the same! If the Government would only leave the thing alone, we should soon have an Imperial wireless service.

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**Engineering Firms and the Wembley Exhibition.**

We stated last week on official authority that the electrical and machinery exhibits at the British Empire Exhibition promised to be on such a scale that, as certain supplementary sections were to be added, the originally specified space would be inadequate. But there are a good many firms in the engineering industry which have not yet taken definite action.

The trade depression, due to so many causes, has not made them enthusiastic to enter upon large exhibition commitments while shadowed by uncertainty. But the present depression will pass as these drear winter months dissolve into spring and summer, and any firm which can afford it should make sure that it has its arrangements made in good time so as to prevent disappointment. We have to draw attention to an announcement appearing in our other pages this week, in which the British Engineers' Association, which is responsible, as our readers know, for organising the "shipbuilding, marine, mechanical, and general engineering" section, intimates its intentions and issues an invitation. The electrical industry touches these different sections of engineering at many points, and their exhibits will call for many electrical requirements in association with them. In addition to that, "general engineering" is so comprehensive a term that it would be difficult to say what it did not include if the exhibiting firm desired it to be elastic. It is not easy, therefore, to see exactly where the line is to be drawn between the two classes of exhibits for the respective sections of the Machinery Hall—but we have no doubt that the two responsible Associations will prove themselves equal to settling the question if it should arise. The announcement of the British Engineers' Association shows that that body has decided to adopt a course of its own in regard to space allotment, for no space in its section has yet been allotted, nor will it be until Thursday, February 1st, when its Exhibition Committee (the personnel of which is given in our "Business Notices" to-day) meets for that purpose. Firms that wish their applications to come before that sitting must make their wants known to the Association not later than Saturday, January 27th.

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**London's Electricity Supply.**

In a letter from Mr. F. W. Purse, of West Ham, published in our columns this week, we are accused not only of vain repetition, but of the pursuit of ideals remote (as ideals often are) and fallacious. Mr. Purse says that he has yet to learn how the reorganisation of electricity supply is going to make any appreciable difference in the matter of the variety of methods, systems, and prices. For our part we cannot conceive any sort of reorganisation which would leave these untouched, and we persist in the attitude adopted in our "Leaderette" last week.

We are sanguine enough to hold that a cheap and abundant supply of electricity is really possible and not so remote as Mr. Purse would have us believe. But the indefinite continuance of existing arrangements must not be permitted, and, unless the Electricity (Supply) Acts are merely expressions of pious hope, will not be permitted.

The changing of systems of supply will necessarily be difficult and entail expense, but we cannot agree that distribution systems will be the chief obstacle. The main burden will be the cost of replacing appliances operated by power; this will principally affect motors. Domestic appliances will not constitute such a serious difficulty on account of their shorter life and easier replacement. Unification of systems will put the manufacturing industry on a firmer basis; with the standard designs which will be made possible "delivery from stock" will become the rule rather than the exception. As we said last week, improvement must come gradually; but it must come.

As for the smaller stations, enough has been said of recent years (taking them as a whole) to show their detrimental effect upon development by their inability to reduce prices to the level which must be reached if electricity is to come into its own. The best authorities are agreed that the remedy lies in concentration of plant—not necessarily in "super-stations" (properly described by Mr. Purse as a "bogey"), but still in groups which would permit of improved efficiency. As the plant in these small stations becomes obsolete, it must either be replaced, or the stations must be superseded by something better; the aim of the Electricity Commissioners, in whom we have the greatest confidence, is to insist upon "something better."

The question of prices is bound up in the foregoing considerations, and we still maintain that the wide difference in prices to be found in adjacent districts makes electricity supply appear an arbitrary sort of business. The ordinary consumer gets his other commodities at prices bearing some sort of resemblance to each other in different districts; he is sure to consider electricity in the same light, and, not being a student of costs, will think he is being exploited. Electricity, in many areas, has forced its way to the front by sheer merit and in spite of high prices, but there is a limit to its growth under such circumstances. We are convinced that if the efforts of eighty-four authorities were co-ordinated and guided by a central authority nothing but good could possibly result.

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**The Electrical Situation in Norway.**

The year 1922 was a difficult period for the Norwegian electrical engineering industry. This statement is made by Mr. Per Kure, principal of one of the Norwegian manufacturing works, in the course of a communication to *Norges Handelstidende*. In explanation he states that stocks had been accumulated when high wages were in operation, and it had been necessary to dispose of these stocks at prices which correspond to the present rates of wages or even at lower prices. That sale prices have so greatly fallen off is attributed to foreign competition in Norway. Countries with a depreciated currency have sent their electrical manufactures to Norway at sale prices, which are far from covering the Norwegian costs of production, particularly as there are practically no import duties on many articles. *Ad valorem* duties are levied on electrical machines, and these duties were justified when they were adopted, but they now afford scarcely any protection in the face of competition from low-value countries.

Mr. Per Kure complains that the Government, the local authorities, and private individuals display scanty interest in the use of goods of Norwegian manufacture. As a significant example in this respect, he refers to the loans of 50,000,000 kronen which the Government granted to various electricity supply works in order to enable them to complete installations which they had begun, a large part of which money went direct to other countries. The demand for large machines is at a minimum at present. The firms producing machines, transformers, and apparatus can now be said to be keeping their works going as a kind of emergency working, seeing that the need is to continue operations as long as possible in expectation of better times.

D

# NOTES ON THE WELDING ARC.

By W. LANGDON-DAVIES.

### "The State of the Art."

"Arc welding practice is in advance of theory. It is an established fact that good welds can be made on any ferrous material if certain conditions are observed, and the standardisation of these conditions has been established for many applications by empirical methods. As usually happens in an empirical art, there is considerable divergence of opinion on many points, which can only be reconciled by the establishment of exact knowledge."

The above is taken from the opening lines of a paper on arc welding read by Mr. J. Caldwell before the Institution of Electrical Engineers, with an appendix by Messrs. H. M. and F. M. Sayers, entitled "An Investigation of the Iron Welding Arc," which was followed by an excellent demonstration, by these gentlemen, of various phases of the working a.c. are thrown upon the screen.*

This paragraph, along with the appendix and demonstration, led me to hope that we should have a real discussion leading to that "exact knowledge" which is so urgently required. These hopes were, however, not realised. With the notable exception of the only lady speaker, the physical, as distinguished from the empirical, side of the question was entirely ignored.

It is in the hope of stirring into life such a discussion amongst your readers that I venture to offer the following notes:—

### Covered v. Uncovered Electrodes.

"For variations in current, the electrode material and arc lengths being fixed, the contact surface areas and the cross-section of the gaseous conductor automatically vary so as to keep the current density in each constant. The resistance of the whole arc, therefore, varies inversely with the current passing. These statements are subject to qualification, but at least are a first approximation."

The above quotation, from the same paper, may serve as a text.

The two statements are:—

(1) The current density in the arc is constant.

(2) The resistance of the arc varies inversely as the current.

I suggest that in practice these proportions are departed from very widely indeed, and that it is due to this being insufficiently understood that much of that "divergence of opinion," at all events for the a.c. arc, arises.

To take the second statement first: "The resistance of the arc varies inversely as the current." If this is the case, then IR = constant, and the volt-ampere curve for arcs of constant length would be a horizontal line (see fig. 1), the resistance curve resembling that shown in the figure.

Mrs. Ayrton, Dr. Steinmetz, and others have given volt-ampere curves of arcs, metallic and otherwise, many of them for alternating current, all of which have a strong family resemblance to one another, and may be represented by the curve in fig. 2.

From this it may be seen that for the higher values of current the curve is fairly horizontal, but for the lower values it shoots up very rapidly indeed. I have found that, roughly, the "elbow" begins between 70 and 50 amperes.

In the case of the direct-current arc, it is quite possible to take some convenient point, such as 50 amperes, and decide that it is inadvisable to try to weld below it, and indeed comparatively little welding is, at present, done below this point; but the problem becomes a very different one when a.c. is used, though, as will be shown later, this sudden rise in the volt-ampere curve, *i.e.*, sudden increase in the resistance of the arc, must be, and is, provided for to some extent in the case of direct current.

* See Electrical Review, Jan. 5th, p. 34.

If you consider the values of current and voltage shown in fig. 2 to be the instantaneous values, instead of the r.m.s. values, and give, say, the point A as maximum current, it is apparent that the arc sweeps from the top of this curve to A and back again twice per period of the impressed volts, *whatever the r.m.s. value of the current used*, and it is obvious that this large variation of the resistance becomes very important indeed.

Before attempting to see how the difficulties arising from this may be coped with, it is just as well to form some idea as to why it takes place, and I suggest the following reason:—

Consider the arc as a conducting cylinder; assuming its length constant, as the current decreases, the cylinder decreases in diameter (you can see that when welding). But whereas the cross-section of a cylinder decreases as the square of the diameter, the (cooling) surface decreases only directly as the diameter. If you assume that the current density remains constant, as stated, then it means that for half the current the cross-section will be half, but the cooling surface is only reduced to $\sqrt{2}$, in which case the arc would cool more rapidly, and tend to get smaller still.

What I suggest really takes place is that the current density goes up as the current decreases, that is to say, the cross-section decreases more rapidly than the current, to such a degree that the increased cooling is balanced by the increased current density and the arc tends to remain at the same temperature. This would account for the more rapidly rising volt-ampere and resistance curves that have been found.

Taking the resistance to current curve (fig. 2), if the above hypothesis is accepted, its rapid rise is due to *the rate of cooling of the arc*, and it must be remembered that this rate of cooling is independent of the electrical conditions. If at any moment, when an arc is running, the current is suddenly switched off, the arc will cool at a rate fixed by the physical conditions of its surroundings. Now it is quite apparent that by attention to these surroundings this rate of cooling can be, to a considerable extent, controlled, as, for instance, by lagging the electrode, and, where possible, the work, and I suggest that, apart altogether from chemical considerations, such as the prevention of oxidation, &c., the various coverings that have been used for electrodes are of the greatest value, especially in a.c. work, as lagging, reducing the rate of cooling and thereby prolonging the time during which the arc is receiving heat.

The a.c. arc is made up of two epochs, one when it is receiving more heat than it loses, the other when it loses more heat than it receives.

Also it is apparent that the resistance of the arc cannot rise to infinity, or the continuity of the circuit would be broken and the arc go out. It is therefore reasonable to assume that the arc must not cool down below a given temperature, past which continuity of the circuit would not be maintained; *i.e.*, the arc may cool, but must not cool *long enough* to fall below a given temperature.

It is found to be more difficult to maintain a steady arc at low periodicities; the reason for this becomes evident on the above hypothesis. In fig. 3, which shows the same volt-ampere curve as fig. 2, the volts and amperes being for instantaneous values, let A be the maximum value reached by the current, then the part of the curve from D to A may be taken as the instantaneous values over ¼ period: at some point along the volt-ampere curve the arc begins to cool more rapidly than it gains heat; for the sake of argument, let this be at the point B.

If the periodicity is 50 cycles per second, then DA is 1/200 sec.; let DB = ¼ of this time, then DB = 1/800 sec.; the total cooling time being from B to D and back to B,

that is, 1/400 sec. Now if the periodicity is reduced to 25 cycles, the total cooling time is doubled, *i.e.*, becomes 1/200 sec., in which time it approaches nearer to, or may even pass, the point at which the continuity of the circuit is broken, depending on the rate at which the arc cools.

If E F is taken to be the volt-ampere characteristic of the circuit, the point B, where cooling begins to take place, may be made to approach D at $B_2$ and thereby shorten the time of cooling, by increasing the open-circuit voltage, using more impedance to keep the welding current A the same, as indicated by the dotted line G H.

It is also obvious from fig. 3 that if the welding current is reduced, that is, if the point A is brought nearer to D, say to K, the point B does not alter, but if D B is equal to B K in time, then for the same periodicity the cooling period will be greatly increased; thus for 50 cycles it will be 1/200 sec. total, instead of 1/400 as shown above—hence the reason why the a.c. arc is generally steadier with a large current than with a small one, other things being equal.

A discussion on covered *v.* bare electrodes then resolves itself into a consideration of how high an open-circuit voltage, how little current, how high a periodicity, and how much lagging or covering it is expedient to use.

Mr. H. M. Sayers has stated that, in some tests he has made, with an apparatus having a synchronous revolving shutter giving observations of the arc at different corresponding periods of the current wave, he has observed with a direct-vision spectroscope that when the arc is at a maximum the iron spectrum is seen with dark (absorption) sodium lines. As the arc diminishes, *i.e.*, the current decreases, the iron spectrum disappears, and only a (now bright-line) sodium spectrum is left.

Apart from the insight into the structure of the arc that this very beautiful observation gives, it at once offers an explanation for a fact that I, in common with others, have noticed.

I have invariably observed that a certain two commercial types of electrode always gave a smoother arc, that is, one without fizzing or sputter, and worked at a lower open-circuit voltage than any others.

The first was an electrode having a wrapping of asbestos yarn, soaked in salt (sodium chloride) and borax, the salts crystallising on the yarn.

The second was an electrode having a covering of asbestos yarn or wool, and an aluminium wire or coat of aluminium powder over the rod under the covering; there are several makes of these.

In the light of Mr. Sayers's observations, the reason for the smooth working of these electrodes becomes clearer, and a very important line of thought is opened for the electrode makers.

It suggests that after the iron vapour has cooled down past the limit of incandescence, and probably past the limit of conductivity, the continuity of the arc circuit may still be maintained by the vapour of a metal which vaporises at a lower temperature than iron, thus prolonging the permissible cooling time, and allowing a lower open-circuit voltage to be used, or welding to be carried on with a smaller current.

It is even possible under these conditions that the resistance of the arc may be found to fall again as the smaller current values are reached.

### The Direct-Current Arc.

A glance at any oscillogram of the current in a direct-current arc shows at once that it is anything but constant; that is, that the resistance varies rapidly, and this is not to be wondered at. When the arc image is enlarged and thrown upon a screen, it is seen to consist of a column of vapour along and about which passes an irregular stream of drops, lumps, or particles of solid or molten matter, one terminal of the vapour column standing on a seething puddle of molten material. As a result, resistance variations of 50 per cent. and more, in less than 1/1,000th of a second, are found; in fact, the effect is as if there were superimposed on the continuous current a considerable alternating current of all sorts of periodicities and all sorts of amplitudes.

It must be obvious, referring back to the volt-ampere curve, fig. 2, that if the current and resistance remained steady at the point A, there would be no necessity to consider any other values on the curve, and it would merely be necessary to work with a slightly higher open-circuit pressure than the arc voltage to just keep the arc to the point A. But owing to the large fluctuations above referred to, many of the considerations applying to an a.c. arc come in. As can be seen from the figure, a 50 per cent. decrease of the current from A would bring the resistance of the arc on to the elbow of the resistance curve, consequently a much higher open-circuit pressure is generally used, about 2½ times the arc voltage, also covered (*i.e.*, lagged), electrodes are found to give a smoother arc, especially when working at comparatively small current values, all of which is understandable if the effect of the rate of cooling of the arc is considered.

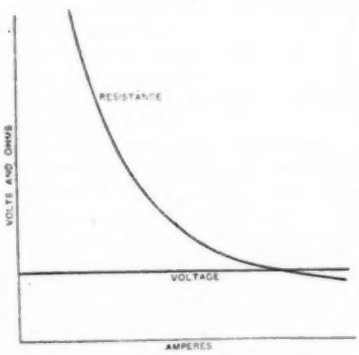


FIG. 1.

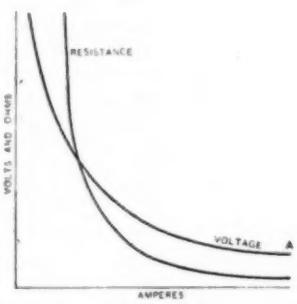


FIG. 2.

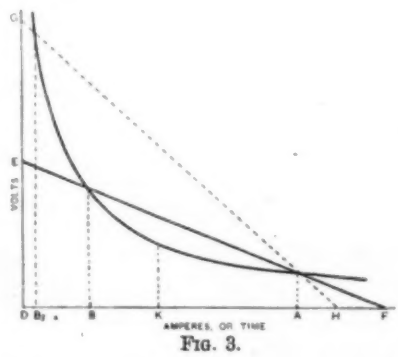


FIG. 3.

Before leaving the d.c. arc, it may be as well to examine the action of the "choke coil," often used in series with it. This piece of apparatus acts as a generator, which will superimpose on the d.c. voltage a varying voltage which varies, as it were, in periodicity, amplitude, and direction with (more or less) the resistance variations of the arc.

Fig. 4 is an attempt to illustrate the action of this coil; the electrode volt-ampere curve is that shown in the other figures, the point A is the welding point, the line E F is the volt-ampere characteristic of the circuit. Suppose the resistance of the arc to vary so that the arc current is varied from A to K, back through A to L, and back to A again, the "choke coil" would tend to superimpose upon the volt-ampere characteristic E F a voltage represented by the curved line above and below E F. These volts are added to the impressed volts when the resistance is rising and subtracted when the resistance falls; in fact, as soon as the resistance of the arc begins to change, the choke coil tends to alter the

characteristic of the circuit from E F to something more like the dotted line G H, *i.e.*, it gives the effect of increasing the open-circuit pressure, and the more rapidly the resistance tends to change, the more rapidly does the line G H slope.

It is apparent that this "choke coil" is of more value when welding with small currents than with large, and is required more for bare electrodes than for covered; its design is well worth care and attention.

### Arc Voltage.

The r.m.s. value of the arc voltage as indicated by a voltmeter does not present any difficulty; the voltage is found to be fairly constant for any current values (that is, the resistance is varying approximately inversely as the current) until the smaller currents, such as 50 amperes and less, are reached; moreover, it is unusual to find much welding done at less than 50 amperes, and even at this current the result is somewhat cloaked by the fact that the operator uses a smaller electrode, and instinctively draws a shorter arc, which is easier to do with a small electrode, and which is equivalent to raising the open-circuit voltage; also small electrodes are apt to have a disproportionately large amount of lagging on them.

It is when as oscillogram of the instantaneous voltage is observed that an often unexpected result is obtained.

The arc-voltage curve is found to rise and fall steeply, and to be more or less flat-topped, varying widely in

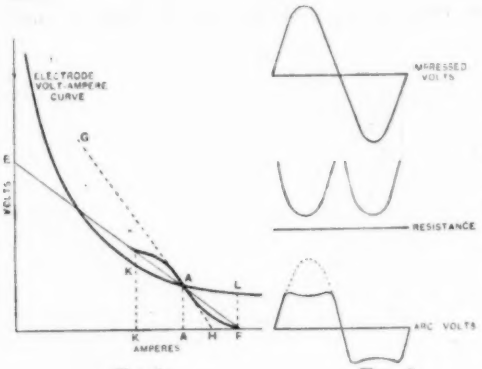


Fig. 4.




Fig. 5.

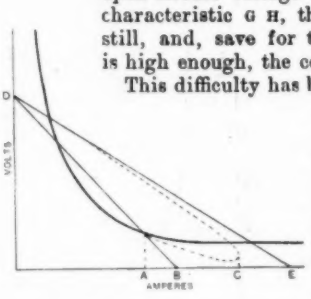


Fig. 6.

shape from the impressed pressure wave. This departure in form is accounted for if you consider the resistance variations of the arc during any half-period.

In each half-period the resistance starts from a maximum, falls to a minimum, and rises to a maximum again—see fig. 5; that is to say, in the arc there is a periodic resistance variation of twice the periodicity of the impressed voltage.

As the arc circuit is given a drooping volt-ampere characteristic, by means of a choke or otherwise, the voltage across the arc depends not only on the impressed voltage, but on the ratio between the instantaneous values of the resistance of the arc and the rest of the circuit, which is practically constant.

When the current begins to rise, the resistance of the arc is high; as the current continues to rise, the resistance of the arc falls, so that the proportionate drop across the arc becomes less than across the rest of the circuit, and thereby flattens the top of the pressure wave.

That this flat-topped wave may be misunderstood is apparent from the fact that I have seen in print an oscillogram showing such a wave taken across an arc fed from a transformer built to have a large inductive drop, instead of using a series choke or resistance, and it was claimed that the shape of this pressure wave was beneficial, and was *due to the transformer*; of course, that is not so; it is due to the arc, and is inherent to *any* a.c. arc on *any* a.c. circuit having a drooping volt-ampere characteristic.

### "Freezing On."

It has been said that a high open-circuit pressure is required partly to enable the arc to be struck. Although an excessive voltage probably enables a very small arc, when obtained, to grow to full size more rapidly, and thus helps, a little investigation of what really takes place will show that the raising of the open-circuit pressure is not the right way to overcome the difficulty.

Anyone who has tried to strike an arc with a bare wire on an a.c. circuit, set to weld at 50 amperes or less, knows what an almost impossible task it is, even when excessive open-circuit voltage is used, and the case is not much improved with covered electrodes.

The end of an electrode is never smooth, and may be considered as having one or more small spikes sticking out from it; in the beginning of the act of striking, one or more of these spikes has to be melted down and subsequently drawn out into an arc. Provided there is current enough available, this metal can be melted at a very low voltage, *i.e.*, the first act of melting the metal is more a question of current than volts.

When this small amount of metal has been melted, it is apt to be squashed out, forming a butt-weld, and if this butt-weld is of sufficiently low resistance to carry the short-circuit current, it "freezes on," and it is impossible to get an arc.

This can be seen from fig. 3, where A is the welding current, and E F the volt-ampere characteristic of the circuit. The short-circuit current at F is not much greater than the welding current at A, consequently when the electrode freezes on, the rise of current is comparatively small, and the butt-joint carries it. If the open-circuit voltage is raised from E to G, giving the characteristic G H, the short-circuit current is smaller still, and, save for the chance above referred to, if G is high enough, the conditions for striking are worse.

This difficulty has been overcome in the "Daysohms" arc welder. This welder is the outcome of several years' work, during which the above notes, and others, were collected, and with it the striking current can be adjusted quite irrespective of the welding current.

The manner in which this striking difficulty has been overcome consists in providing that the whole of the choke, in circuit when welding, is not brought into circuit until after the arc is obtained; it then comes in automatically.

This action is illustrated in fig. 6, which shows the volt-ampere curve of the arc having the welding point at A; D B is the welding characteristic when all the welding choke is in, D F is the striking characteristic of the circuit when part of the choke only is in. From this it can be seen that if the whole of the choke to give the welding point A with the open-circuit voltage D were in when the arc was being struck, the maximum available current would be very little more than the welding current, *viz.*, B as compared with A. But whenever the arc is broken, the machine sets itself for the characteristic D E, and the maximum available current is E, double the welding current (this can be adjusted to be more or less as required).

During the striking of the arc, the volt-ampere characteristic may be roughly represented by the dotted curve D C A, where C is the actual striking current; as soon as the arc begins to form, the current falls, and the pressure rises until the welding point A is reached. This enables the arc to be struck, even for very small welding current values, without having recourse to the excessive open-circuit voltage mentioned above; in fact, the arc can be *started* at lower open-circuit volts than it would be possible to weld with.

The striking characteristic D E is made adjustable quite apart from the welding characteristic D B for two reasons.

The first is because it has been found that the excess

of striking current over welding current is not nearly so great for the larger welding-current values; indeed, for 150 amperes and over, it is hardly necessary for the welding current to be exceeded, whereas for 25-ampere welding a striking current of as much as three times that amount may be required. The reason for this is probably due to the fact that the small spikes, or roughnesses, on the end of the electrode are not much greater for large electrodes than for small, and the current required to melt, and keep melted, a few of these is more or less a fixed quantity.

The second reason is that for thin work, such as 1/32-in. steel, it is necessary to keep the striking current down to the smallest possible amount; a flare of current on striking is apt to go through the work, and start cutting.

The welder designed in this manner is capable of welding at from 20 to 200 amperes, with a current adjustment in infinite gradations, and the arc may be struck with the lowest possible open-circuit voltage.

In conclusion, I should like to point out that none of the curves given must be looked at in a quantitative sense. They are merely pictures, intended to show the general trend of affairs, and are often exaggerated to illustrate the subject more clearly; for instance, all volt-ampere characteristics of the circuit are given as straight lines, whereas they are usually curved, but this does not affect the main issue.

I should also like to point out that, although I have only referred to the covering of electrodes as "lagging," I am fully aware of much of the admirable work that has been done in the addition of chemical matter for the production of special welds. I have seen rustless steel welded to rustless steel, *with a rustless steel weld*, and other fine achievements of this nature. I have purposely stuck to the lagging because I do not think its value has been sufficiently appreciated; some day we may see the heat-conducting chemical matter put on the stick first, with a covering of lagging on top—who knows?

## BOILER-HOUSE RECORD KEEPING AND APPLICATION.

By CHAS. F. WADE, A.M.I.Mech.E., A.M.I.E.E.

THE boiler house of an electricity works is a factory for the manufacture of heat in a useful form from the raw material or fuel. In any factory it is essential that careful record be kept of how the material is disposed of in order to locate and eliminate waste to the utmost possible degree. In the boiler house of an electricity works this elimination of waste is more important than in many other industries, where the fuel cost is not such a preponderating item on the cost sheet, and fortunately the vast majority of power-station boiler houses are so laid out that they lend themselves admirably to the accurate recording of running conditions and results.

In spite of the importance of accurate records as an essential for maximum economy, it remains a fact that the majority of stations are as yet unprovided with any system of record keeping, or means of collecting the data for such records, while of those stations where records are kept, there is a very large proportion which do little more than file them away; the plants where the records are accurately kept, analysed, and the results applied in practice for the utmost reduction of the fuel bill are in a comparatively small minority.

As the success attained in reducing the fuel bill to its lowest possible figure depends very largely upon the making manifest of several conditions which are ordinarily invisible, it is obvious that apparatus must be employed for this end. Rule-of-thumb methods are absolutely useless to obtain anything like conditions of efficiency in the modern acceptance of the term.

In devising a system of record keeping and analysis, it is necessary clearly to bear in mind the purposes to which records are to be ultimately put.

The mere registration of water evaporated and feed temperature, steam pressure, and superheat, together with the coal consumed and its calorific value, although furnishing data for the calculation of the efficiency of the plant as a whole, are of little value as a guide to the improvement of results obtained. What appears to the writer to be the logical course of action is in the first place to determine exactly how and when losses are taking place, the reduction of these being the most important object in view.

The principal losses in a boiler plant will take place—

By way of the waste gases,
On the ash heap,
Convection and radiation,
Excessive blowing down,
Blowing off at the safety valves,
Low steam pressure,

of which the first item is the most important.

The defects that make themselves manifest in the temperature and analysis of the gases are those that lead to the greatest waste of fuel, *viz.*, incorrect firing and air regulation, unsuitable fuel, incorrect feed regulation, dirty heating surfaces either internally or in the flues, air leakage through the brickwork settings and "short-circuiting" or faulty circulation in the boiler due to excess of solids in solution or other causes.

Although a record of $CO_2$ is essential, it tells us but little when unaccompanied by a corresponding record of the temperature of the gases. The only case in which the $CO_2$ recorder gives us definite information is when there is no excess of air; when the reading is low there is no guide whatever to the cause of the bad results.

Thus we now have two essential records, namely, temperature of waste gases and $CO_2$.

The next item, the ash heap loss, can only be determined by the analysis of a fair sample of the ash heap, and should it be desired to determine *when* this loss is most serious, a representative sample for each shift will be required. For all practical purposes, however, a daily test of the ashes sent away will suffice until this loss is found to be getting serious, when the time at which this takes place will have to be definitely determined.

*Apropos* of ash-heap losses, it is seldom that these reach any serious amount. Take, for instance, a case in which coal of 13,000 B.th.u. per lb. is in use which shows 10 per cent. of ash by analysis; ash-heap analysis may show a combustible content of 10 per cent., which is comparatively high. The loss in such a case would only amount to about 1.25 per cent. of the total coal used.

Actual determination of the percentage fuel loss in the ash heap calls for an ash test of the original fuel, by which the loss by combustible (calculated as carbon) in the ashes may be estimated.

Blowing off at safety valves and low steam pressure will be recorded on a carefully adjusted recording pressure gauge. This will also be of assistance in working out efficiency figures.

The apparatus required for producing records that will indicate the directions in which losses are taking place are therefore a $CO_2$ recorder, recording pyrometer or (for water-tube boilers) mercurial thermograph, steam pressure recorder, and ash testing apparatus.

For the use of the chief engineer, however, it is necessary to provide returns of the thermal efficiency of the plant, as this is the ultimate figure that is influenced by improvements brought about by intelligent application of the records already described. This requirement calls

for a considerable addition to the recording apparatus, namely, water meter; steam temperature, economiser feed inlet and outlet temperature recorders; coal calorimeter, and coal consumption.

To a properly qualified combustion engineer these data will be of but little use, as by knowing how losses are taking place from the use of the first-mentioned instruments, &c., he will be able to correct them as far as possible, the efficiency rising as a matter of course.

The actual value of continuous records of efficiency data is therefore of doubtful utility, beyond providing results for the benefit of those to whom the loss figures would convey but little. For the purpose of reducing the fuel consumption, a periodical efficiency test would be ample for checking purposes, and daily records of running efficiency, being of little practical value, are to a large extent a waste of time and as such apt to make the work tedious and uninteresting. It is in those stations where the record keeping is overdone that the whole business becomes merely a matter of routine, the records obtained being worked out in a mechanical sort of way and ultimately being filed away and forgotten.

Even in plants where the records are carefully kept and the results worked out, there are some points that are very often overlooked, and if not attended to are likely to lead to erroneous conclusions. This remark especially applies to methods of averaging. Taking as an instance that it is desired to ascertain the percentage loss of fuel by way of the waste gases, and that a set of records of $CO_2$ and temperature are available. The usual method of calculating the loss will be to find the average of readings for the period under consideration and to obtain the approximate loss from the usual published tables or by calculation from analysis of the fuel. While in such cases where the fuel consumption has been fairly constant throughout the period under examination, this method will give the chimney loss with fair accuracy, in cases where the fuel consumption varies to any appreciable amount the results obtained will be far from accurate. In order to arrive at the real loss it will be necessary to know how much fuel has been burned at each percentage of $CO_2$ and temperature. The same applies to steam pressure and temperature and feed temperature readings, where, to obtain true averages and accurate results, it is essential to know the amount of water evaporated at the various readings obtained. It is attention to such points as these that determines the real value of the various results arrived at.

To work out a set of data obtained from a day's working of a power-station boiler house is a long job, if it is going to be done properly, and it is safe to say that but few engineers work out their figures to that degree of accuracy that would warrant the description of *scientific* being applied to the methods of control. The fact that accurate record keeping and supervision of the work of even a small boiler house calls for more time than the all-round shift engineer has at his disposal to devote to it, emphasises the importance of placing the whole of such duties in the hands of a special man who is free to confine his expert knowledge to efficient steam raising.

The value of records of losses and performance of steam plant depends to a very great extent on how they are finally set out. A mere statement of the various losses, together with the efficiency, made up into a heat balance, will not carry us far unless these are accompanied by a statement of the causes of unsatisfactory performance, if such is found. Again, space should be provided on the record sheet or card for the entry of the steps which are taken to correct the irregularities observed.

The best way of all in keeping records is to use the graphic method. Two charts should be plotted, each of which should consist of a number of curves. The first chart would be constructed from the various records obtained by means of the recording instruments, and would contain the "raw material," as it were, from which the second chart is prepared. The latter should show the shift-by-shift heat balance, being divided vertically into 100ths and horizontally into 21 divisions spaced about an inch apart. Ample space should be provided at the bottom of this chart for the entry of references as to causes of poor results and action taken. By the use of the standard "medium" size of sheet, or the slightly larger "Royal" size, the space available will be used economically. If the card system be preferred, and it is certainly much more convenient for ready reference, as large a card should be used as will allow the scale of the charts to be sufficiently open to be clear and readily interpreted.

It will doubtless prove useful to run over the various data required for constructing the heat balance, and the following table may be of assistance to those engineers who are desirous of instituting a complete system of records for the purpose of reducing their coal consumption. A summary of the principal causes of loss under the various headings is also given. The complete outfit of instruments is as follows:—

- Apparatus for determining the calorific value and ash content of coal.
- Steam flow meter on each main.
- Steam pressure recorder.
- Steam temperature recorder.
- Water meter and flow recorder.
- Feed temperature recorders.
- Recording draught gauge.
- Combustion indicator, indicating draught gauge and steam flow indicator on each individual boiler.
- Water analysis equipment.
- Recording thermometers for gases leaving water-tube boilers and economisers.
- Thermo-couple recorders for gases leaving Lancashire, &c., boilers.
- $CO_2$ recorder, salinometer.

| Item on balance sheet. | How obtained. | Causes of loss. |
|---|---|---|
| Total heat of 1 lb. fuel as fired. | Calorimeter test. | —— |
| Heat recovered in boiler. | Steam flow meter, steam press recorder. | Dirty heating surfaces, air leakage, faulty firing and air regulation, short circuiting of gases. |
| Do. superheater. | Steam temperature recorder. | Dirty surfaces, priming, short circuiting. |
| Do. economiser. | Water inlet and outlet recording thermometers. | Dirty surfaces, air leakage, short circuiting. |
| Loss in waste gases. | $CO_2$ and temperature of gases leaving boiler, less economiser recovery. | Faulty firing and air regulation, dirty surfaces, air leakage and short circuiting, irregular feeding, forcing boiler beyond economical capacity. |
| Do. ash heap. | Analysis of coal and ash heap. | —— |
| Do. blowing off. | Comparison of water and steam flow meters. Steam press-recorder. | —— |
| Do. blowing down. | Calculation from amount of lowering of water in boilers, &c. | Untreated water. Rule-of-thumb methods. |
| Do. "radiation." | Still test on standing boilers. | Inefficient and defective coverings, draughty boiler house. |
| Do. unaccounted for. | By difference of 100 per cent. | Combustible in flue dust. High hydrogen content of coal. Moisture and wetting of coal. |

It is outside the scope of this article to consider the methods of dealing with the various losses, &c., and the subject would provide matter for a considerable-sized volume.

Whatever be the size of the plant, the same considerations will always enter into all questions of fuel economy, the principal difference in the larger plant being that it would be the best procedure to equip each unit separately as a complete plant, with its own outfit of controls.

**Radium in Ireland.**—Lecturing at the Royal College of Surgeons, Dublin, Mr. H. Poole, D.Sc., said that some of the best radium came from Ireland, Carlow radium, for instance, being remarkable for its excellent quality.

# THE PHYSICAL SOCIETY OF LONDON.

## EXHIBITION OF SCIENTIFIC INSTRUMENTS.

THE thirteenth annual exhibition of electrical, optical, and other physical apparatus, that is held under the auspices of the Physical Society of London and the Optical Society, was as usual housed in the Imperial College of Science and Technology at South Kensington on January 3rd and 4th. Bearing in mind the fact that this eagerly looked-forward-to show affords an opportunity of gauging to some extent the progress that has been achieved in the design and construction of scientific instruments during the previous 12 months, the two days during which it lasts seems too short a period in which to inspect all one would wish to. Many electrical devices were to be seen amongst the apparatus shown by the 56 exhibitors who took part this year, and discourses by Mr. W. Gamble on "Reproduction of Colour by Photographic Processes," and by Prof. E. G. Coker, F.R.S., on "Recent Photo-Elastic Researches on Engineering Problems," had been arranged.

### Edison Swan Electric Co., Ltd.

The EDISON SWAN ELECTRIC CO., LTD., displayed a collection of Pointolite lamps, from 10,000 to 30 c.p.; neon lamps, thermionic valves; and ignition testers. Type No. 1 is flat, shaped like a miniature cigarette case, and provided with two contact points which can be folded out of the way when not in use and a circular aperture through which the indicator neon tube can be observed. To ascertain the condition of the spark in the sparking plug, the contact points are placed across the sparking plug and the indicator neon tube is observed. A bright flash indicates correct sparking or sparking in the alternate gap of the magneto. A faint flicker indicates too long a spark gap, or insulating matter clogging the spark gap. No light indicates no potential across the plug, or shorted plug.

Type No. 2 is tubular and provided with two observation windows and a metal contact cap. When the latter is placed on the h.p. terminal of the plug, a flash in the upper observation window indicates correct sparking. A flash in both observation windows indicates too long a spark gap, or insulating material clogging up the spark gap. No light indicates no potential across the plug, or shorted plug.

### Zenith Manufacturing Co.

The ZENITH MANUFACTURING CO., showed resistances and rheostats of many kinds, including patterns suitable for regulating the filament current of thermionic valves, even of large silica ones, and insulated to operate at 10,000 V; also "Zenite" vitreous embedded resistances, not excluding patterns for use as "grid leaks" in radio transmitters, and transformers for producing h.p. rectified current for the plate circuits of transmitting valves that are equipped with extra secondary windings for lighting the filaments at the same time. Combinations of choke coils and condensers as ripple eliminators for use with the above-mentioned transformers were demonstrated under working conditions as was also the "Acdic" electrolytic rectifier which ensures, it is said, practically perfect rectification, as demonstrated by oscillograph records. The device (fig. 1, Mr. M. A. Codd's patent)

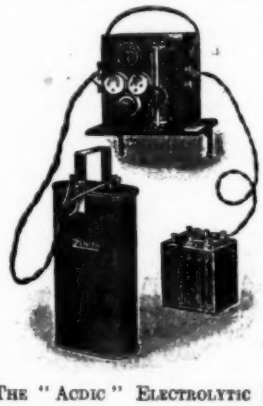

FIG. 1.—THE "ACDIC" ELECTROLYTIC RECTIFIER.

is a form of electrolytic cell, comprising a tank with a cover in two separate halves, each of which carries a rectifying electrode of chemically pure aluminium. It is arranged so that when the lid is replaced, the electrodes automatically assume the correct position without any danger of short circuiting, and a switchboard with the necessary instruments, which regulates the amount of charging current, is mounted on a ventilated box that houses a double-wound transformer; this not only dispenses with the losses incurred when using resistances for charging purposes, but also serves to completely isolate the user of the device from any accidental contact with the main supply, thus all danger from shocks is avoided. The whole equipment can easily be carried by one person. The cooling tank is an inexpensive, but important, unit as its use ensures the temperature of the electrolyte remaining below 60 deg. C. even on continuous day and night use, but a pail or bath can be substituted where first cost is of great importance.

It is claimed that the "Acdic" rectifier has the following exclusive features:—

It is self-starting and automatic in operation.

It does not require constant attention, or expert knowledge.

It rectifies both half waves of the complete alternating current cycle.

No delicate bulbs to break, burn out, or replace.

The only wearing parts are the aluminium electrodes, and the solution, which can be replaced by any inexperienced person.

It may be worked from any lamp holder, as the 5-ampere size consumes less current from the mains than an ordinary metal lamp.

The battery cannot be harmed, even though left on charge indefinitely.

Absence of noise, vibration, moving parts, and oil.

### H. Tinsley & Co.

Amongst the varied exhibits on the stand of MESSRS. H. TINSLEY & CO. the two phonic motors were worthy of notice. They have been developed to provide a standard of speed capable of doing a fair amount of work. A tuning fork, which is self maintained, controls the motor and only one source of direct current is required for its operation. The motors are wound for any voltage (from a few volts upwards) and made in two sizes, the larger of which is sufficiently powerful to drive a commercial type of kinematograph camera at a perfectly constant speed. A special type of tuning fork is made for controlling the operation of these motors, constructed to run continuously and without attention for long periods. Special features have been introduced in the contacts which govern the interval of time during which the contact is definitely closed. Several motors can be controlled from the same fork if necessary, thus ensuring the absolute synchronism of each.

Application of this mechanism has been made to a variety of problems, amongst which are:—Speed measurement, generation of constant e.m.f.'s and frequencies, measurement of slip and synchronising of machines, measurements of spark discharges, synchronous operation of the kinematograph and voice production, production and reproduction of gramaphone records, synchronous operation of automatic telegraph apparatus, automatic speed control of other motors, calibration of tuning forks, &c. Although not primarily intended for the purpose, the motors run perfectly from any a.c. supply at commercial frequencies; they are not self starting, but one important feature of their design is the ease with which they drop into synchronism when spun at any speed about this value. The large motor weighs 10 lb., and its dimensions are 5 in. x 5 in. x 4 in.

The function of the Anson relay is to rectify and amplify received radio signals, so that they can be made to operate auxiliary apparatus for producing a record. If a valve-amplifying set is used for this purpose and the recording instrument is placed in the plate circuit of the valve, the adjustment becomes very critical as the zero is continuously wandering and creeping with variation in filament temperature and signal strength, so that this method is not very useful. If however, a large ballast resistance is placed in the plate

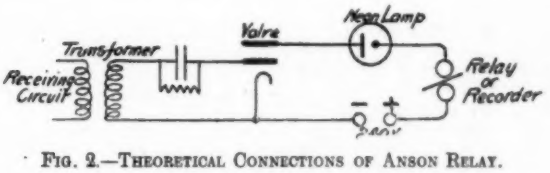


FIG. 2.—THEORETICAL CONNECTIONS OF ANSON RELAY.

circuit, the current in that circuit tends to become constant and conditions are far more favourable. Unfortunately, the amplification is impaired in direct proportion to the improvement in steadiness so that the final result shows no advantage.

The invention covered by the Anson patent consists of using a ballast resistance of such a type that the amplification is not impaired, but actually increased. This is brought about by using a resistance which decreases rapidly with the increase of potential drop across it. A neon lamp is used to obtain this characteristic and the resulting conditions are such that a relay requiring a current change of about one milli-ampere for its operation can be worked in the plate circuit of the valve containing the neon lamp with perfect

steadiness, in spite of fluctuations in the filament temperature and signal strength, and variations in the h.p. battery.

The voltage upon the grid of the valve used in the relay portion of the instrument necessary to produce one milliampere change in the relay circuit, depends somewhat upon the speed of the signals it is required to record, but in practice conditions capable of recording up to the highest commercial speeds require about 5 volts change on the grid. As a 5 to 1 ratio transformer is used in this circuit, the actual voltage change required at the terminals of the Anson relay to produce the one milli-ampere change in the relay circuit is about one volt. The device, furthermore, has the advantage of being linear in its amplification, so there is very little distortion in the magnitude of the signal received and that of the signal recorded, so that by using a more sensitive relay proportionately weaker signals can be received. Fig. 2 shows the theoretical connections used in the simple type of valve circuit employed in the present form of instrument, and it is found in practice that good records can be made, when using a 3-valve receiving set connected to the primary of the transformer of the Anson relay and a Post Office relay in the neon lamp circuit, from most of the Continental stations of importance. When necessary to receive weaker signals, a more sensitive relay and increased amplification on the receiving set should meet the most stringent requirements.

The importance of a mutual inductance standard which is constant with frequency is very great. With the type made with a stranded conductor, where the range is varied, by using one or more strands of this conductor to increase or decrease the number of turns of the coupled windings, the errors due to intercapacity introduce serious difficulties when used over a long range of frequency, on account of the large number of sections in series forming a step-up transformer with respect to the single sections as pointed out by Mr. S. Butterworth. With inductors of the above type a correction amounting to 0.07 per cent. has been found necessary when calibrated at 50 cycles and used at 1,000 cycles. At the suggestion of Mr. S. Butterworth a variable mutual inductance has been developed which is built upon the following principle:

The primary winding is provided with three secondaries having values of mutual inductance of 1, 3, and 6 units. The intercapacity between these sections is kept very small and their own bulk so arranged to reduce their distributed capacity; also their capacity to primary is kept very small, the result being that the total errors due to capacity are kept down to a minimum. The conductors are of very highly stranded wire, each strand being insulated with a double silk covering. The method of building up values is as follows:—One unit is obtained from the secondary having the mutual inductance with the primary of 1; similarly the values 3 and 6 are obtained from the secondary having these values in respect to the primary, and the other values are made by positive and negative combinations of these three units automatically by a commutator, which has the appearance of an ordinary switch dial.

In this way a variable mutual inductance standard (fig. 3) has been built up having a normal range of 10 millihenries down to 1/10th microhenry, consisting of two dials of 10 points each on the 1, 3, and 6 principle, and a variable section reading from minus 10 to plus 10 microhenries. The scale is so arranged that the 0 to plus or minus 1 is very open, and after that the intervals are uniform.

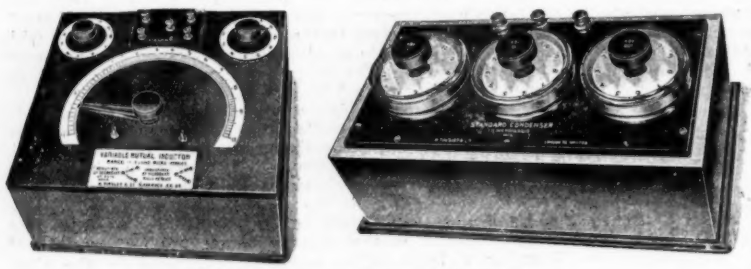

FIG. 4.—VARIABLE STANDARD CONDENSER.

For precise inductance and capacity measurements a high grade variable standard condenser is of great importance. To meet this requirement the firm has recently developed a new three-dial slide condenser, fig. 4, wherein the resistance of the contacts and their self-induction have been kept down to minimum values. By building up each dial with four units of capacity, namely, 1, 2, 3 and 5. The units are added automatically by a switch so that all values up to ten are obtained by turning the knob, as with an ordinary type of slide condenser. The suggestion of these values is due to Mr. Dye, of the National Physical Laboratory, and has the advantage that at intermediate points between studs there is no excessive jump in the value of the capacity connected up momentarily, an advantage that will be realised by those familiar with bridge measurements.

The usual value made in these condensers is the total value of 1.11 microfarads and, when used in conjunction with a continuously variable air condenser of total capacity .0012 microfarad, this forms a very useful standard reading to 10 micro-microfarads. The three-dial condenser is provided with a third terminal, connected to the metal case in which the units are enclosed, that permits of an exact allowance being made for capacity to earth in the case of precise measurements.

*(To be continued.)*

## THE DEVELOPMENT OF CALLENDER'S COMPANY.

ONE of the best-known British cable-manufacturing and laying companies in this country, which also possesses a long-standing fame and reputation in foreign markets, is Callender's Cable and Construction Co., Ltd.

The original business of Callender & Sons, out of which the company developed, was founded in 1877 by the late William Ormiston Callender and his two sons, Thomas Octavius and William Marshall. Mr. Callender (Senior) had been engaged for many years in the asphalte industry in connection with street paving at home and abroad, and was instrumental in bringing into practical use the asphalte deposits of the well-known pitch lake in Trinidad, which still remains the main source of supply of the genuine bitumen of commerce.

The business of this firm was to refine the Trinidad bitumen and to use it for various commercial purposes, in addition to paving. It had its office in Leadenhall Street, London, E.C., and its works at Millwall, E.; the latter, in February, 1880, were removed to Erith.

In the course of experimenting with bitumens a process was discovered, and a patent was granted to Mr. W. O. Callender in 1881 for improvements in the manufacture of compound materials, which covered the substance since so well known in the electrical industry as vulcanised bitumen. In order to develop this new invention a company was formed in 1882 called Callender's Bitumen Telegraph and Waterproof Co., Ltd., which took over the refining and waterproofing business of Callender & Sons and proceeded to develop the manufacture of insulated wires and cables. It may therefore be said that the inception of the company coincided with the practical beginning of the electrical industry as now understood.

During 1882 a number of orders were received for underground mains for pioneer installations in various towns and for private house installations, and shortly thereafter, when electricity supply was undertaken by authorised distributors, and mains began to be laid in the streets of London and elsewhere, the real business of the company commenced in earnest.

As is now a matter of history, the early days of the electric lighting industry were seriously hampered by the conditions imposed by Parliament, causing much difficulty in obtaining money to carry out any large scheme of general supply. The first company in Great Britain which laid down plant and mains for giving a general supply within its area in the terms of then existing Acts of Parliament was the Chelsea Electricity Supply Co., Ltd., which was registered in 1884 by the late Major-General Webber. It obtained its Provisional Order in 1886, and immediately commenced the work of installing its station and laying down its mains. It was impossible to raise all the capital then required, and the Callender Co., along with other contractors, the E.C.C. and the E.P.S. Co., took payment of a large portion of their contract in shares of the company, thus enabling the venture to proceed.

Similar financial assistance was given in many instances, and from the very beginning the Callender Co. has adopted the policy of helping the industry and the companies which were formed for the distribution of electricity. This was especially marked in the early days of the present century, when various electric power companies were formed, in many of which the then Callender Co. took a prominent part and gave the much-needed financial assistance which enabled the undertakings to develop.

When the laying of mains actively commenced in London a large part of the work fell to Callenders owing to the experience which they had had in past years in street work and their ability to undertake, not only the supply of the cables, but their laying complete, with the excavation and reinstatement of the roadways.

The extension of the company's business soon necessitated its reorganisation, and in 1896 Callender's Cable & Construction Co., Ltd., was registered with an increased capital to take over the old C.B.T.W. Co. Further land was acquired

at Erith, and the present works were constructed, and have been extended as developments in the type of cable took place. The works at Erith now include foundries and machine shops for making boxes and other fittings, and more recently their Picardy works (originally built during the war), which is claimed to be the most up-to-date telephone cable factory in existence.

In 1903 the company acquired all the shares in the Anchor Cable Co., Ltd., at Leigh, Lancashire. The factory of this company is devoted to the manufacture of rubber wires and cables of all descriptions, and is one of the largest in the kingdom.

## LEGAL.

### Jenner v. Leslie Dixon & Co.

IN the Mayor's and City of London Court, on Monday, before his Honour Judge Atherley Jones, K.C., a claim was made by Mr. Clifford G. Jenner, electrical engineer, 165, Church Road, Mitcham, against Messrs. Leslie Dixon & Co., 91, Queen Victoria Street, E.C., electrical engineers, for £100 damages for breach of an agreement of December 13th, 1920, whereby defendants agreed not to advertise in the *Model Engineer*, and certain other papers. Mr. Werninck, for the plaintiff, said that the claim was for breach of an agreement entered into on December 13th, 1920, between plaintiff and Mr. Dixon on behalf of the defendants. The contract was that the plaintiff should buy 100 Lucas aero dynamos at £2 each. They were to be taken in two deliveries of 50 each. The parties proceeded to make an agreement as to advertising in various trade journals. Defendants had got an exclusive consignment from the Disposal Board and an arrangement was made of which the contract was the outcome that plaintiff should acquire some of them from the defendants and that then they should divide the advertising field between them so as not to come into undue competition. It was in respect of the advertising part of the contract that the action was brought.

The JUDGE: The plaintiff's damage would be the amount of the custom that the plaintiff has lost?

Mr. WERNINCK said that was so by reason of the defendants having in breach of the agreement advertised in the papers which were reserved to the plaintiff and prohibited to the defendants. The measure of the damage was the profit that would have been made by the plaintiff on any sale effected by the defendants.

The JUDGE did not think it followed that the plaintiff would have made a profit on the sale of the dynamos.

Mr. WERNINCK added that it was agreed that the retail selling price should not be less than £5 each. Defendants had advertised in plaintiff's papers and so made a profit which would have gone to the plaintiff. Sometimes both advertisements appeared in the same papers.

A good many details in the case were discussed, in the course of which the Judge said that he noticed that the defendants had paid £35 into Court with a denial of liability, and he inquired how it was arrived at. Mr. Howard said it was the largest sum that plaintiff could possibly be entitled to.

Plaintiff, in cross-examination, said that defendants bought 900 or 1,000 of the dynamos from the Disposal Board, but that did not give them a monopoly. After further hearing judgment was given for the plaintiff for £35.

**Trade Conditions in South Africa.—THE INADEQUATE PREFERENCE.**—We have received a copy of the report of the Council of the British Manufacturers' Representatives' Association of South Africa (Inc.)—(rather a big mouthful!)—in which is set forth a full account of this useful organisation's activities during the year 1922. The membership at 433 shows a net increase of 32 for the year. An unfortunate part of the report is the paragraph in which trade conditions are referred to: "The conditions of trade during the past 12 months from the point of view of Representatives have been possibly the worst on record." The trouble on the Rand, culminating in the revolutionary strike, upset all calculations, and "eloquent testimony as to the slump that has taken place is to be found in the official figures with regard to insolvencies." In 1920 the total was 649 and in 1921 no less than 2,146, while during the first half of 1922 the number was 1,017, the deficiencies involved in the respective periods being £600,000, £1,950,000, and £800,000.

On the subject of British preference, the Council agrees with the view of the South African Chambers of Commerce that, considering the very generous preferential duty given by the United Kingdom to goods of South African origin, the present rebate of 3 per cent. granted by South Africa to British goods is totally inadequate. A hope is expressed that the Government will favourably consider the grant of a more generous preference at an early date.

## CORRESPONDENCE.

*Letters received by us* **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

### Highest-Voltage Power Transformer.

I shall be obliged if your readers will kindly inform me if any power transformer has yet been built in this country to operate at or above 60,000 volts. That is to say:—

(*a*) As a single-phase unit for a single-phase or a three-phase circuit, so that the total phase-winding is the line voltage.

(*b*) As a three-phase unit so that each phase-winding is connected across two phase conductors of the line.

(*c*) Ordinary single-phase unit (total winding in series) with two insulated terminals leaving the transformer tank.

(*d*) Ordinary three-phase unit (total winding of each phase in series), the unit connected in delta on the line side.

(*e*) Ordinary single-phase or three-phase unit designed to operate at or above 70,000 volts, single-phase, 70,000 volts to earth, and 70,000 volts, three-phase; or 70,000 x $\sqrt{3}$ volts, three-phase.

**William T. Taylor.**

London, *January 3rd*, 1923.

### The Development of Empire Resources.

Your article on Empire Resources is very much to the point.

I beg to enclose the outlines of a scheme which well fits in with the views you express; there must be numerous large electrical schemes in British Columbia, Canada, or Australia which require British capital, and could employ a large quota of British labour.

During construction, if migrants are sent out on the County Scheme lines (or under other semi-public bodies) they can learn the conditions of the country, perhaps of the land or of other industries, while being employed. They at least are guaranteed work for the first few months after landing. And when power schemes are completed, it is obvious that new industries will start to make use of the extra power.

There are several complaints in your REVIEW that American capital is out-pacing British capital in Canada; *vide*, November 17th, "The Future of Electricity in Canada," p. 699, by E. T. Davies. Strategically there is a great danger in vital points such as British Columbia.

Might I suggest that you publish weekly outlines of power schemes in Canada or other Dominions which could be usefully undertaken on the lines indicated, to employ, in part at least, British labour and British capital? The labour would be sent out on collective migration lines. The capital might be encouraged by Government loans, through the Trades Facilities Act; or compare the Sudan Loan.

Plymouth is now working out a scheme for West Australia, using a railway as a primary stock job. The Rutenberg schemes of the Jordan Valley have as a basis the employment of Jewish immigrants to find them work now and the creation of industries later using cheap power.

**Migrant.**

*January 2nd*, 1923.

[The following is one of the communications referred to.—EDS. ELEC. REV.]

**Various big schemes are being put forward to relieve unemployment; some possibly remunerative, others merely desirable. None will cure the disease, since all are temporary measures.**

Big development schemes in the Dominions can be put forward involving no greater outlay of capital, giving a far more certain return, and leading to further employment for those engaged.

We seem to forget that England is merely the centre of an Empire, not a self-contained country.

Let each county or territorial unit or corporation be allotted a given area in the Dominions and invite the closest co-operation of that Dominion.

Survey and work up the necessary plans for developing that area; whether they be for roads, railways, power schemes, canals, irrigation or building farms over the area, clearing the land, &c.

Draft selected bodies of men of necessary trades from England and combine with leading hands from the Dominions. Or big firms might draft out half their personnel for new works or mines or a combination. By the Empire Settlement Act part passage is paid.

Migrants from this country will then have a definite job to go to which they can undertake at once, for all men can dig; and from this stock job they can gradually pass on to farming or whatever other work they find to suit them.

Make use of all the latent forces lying dormant since the war, of various philanthropic bodies, willing to help if the way is shown. With such a programme there will be ample scope for them in helping wives, looking after families till

they can follow, in keeping touch between the home country and the new one.

Finance is the root of the question, but if money can be found for temporary palliatives in this country, why not for a permanent cure in the Empire? We can make use of the Empire Settlement Act and Trades Facilities Act and enlarge them. America is now pouring capital into Canada.

If we are bought out there, and the danger is obvious, posterity will blame us; and if it is a business proposition for America, surely we can see what will pay us. The Prime Minister and financiers have admitted that temporary inflation is justifiable for profitable schemes.

As regards Canada, the rise of sterling, the Fordney tariff and the removal of the embargo are all in our favour.

Australia is anxious to co-operate and would alter minor points in legislation to assist. Similarly with New Zealand.

Migration is slow now because the Dominions mainly demand farm workers, domestic servants or men with capital, because they rightly do not want to take over the burden of our unemployed.

But with the above scheme, where work can be guaranteed for a year or so to almost any migrant the risk of shifting our responsibility is minimised.

Migrants going out almost in battalions with their friends and to their friends will go in far greater numbers than now, where each goes as an individual with no one behind him to look after his family and an unknown destiny ahead.

There is naturally much more to be said on collective migration and development on mass production lines and its methods of working, but space forbids.

Plymouth is already taking it up and working out details.

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### Hints on Radio Merchandising.

I note with interest your editorial remarks, and the article on page 990, on "Hints on Radio Mechandising."

There can be no question but that the public interest in radio broadcasting has come so suddenly, and has developed so rapidly, that the electrical contractor and trader find considerable difficulty in deciding as to the most suitable apparatus to stock and to sell. Equally, there is no doubt that a somewhat different technical equipment is necessary for this kind of work, as compared to the usual requirements of electrical contractors and traders.

The purpose of the present communication is to bring to the notice of your readers that there are at present at least 120 radio societies and clubs throughout the country, which would be glad to welcome contractors and traders as members and offer, by means of lectures and personal instruction, adequate facilities for becoming acquainted with radio matters which will, in turn, enable them to handle this business with greater benefit to themselves and to their clients.

**Radio Society of Great Britain.**
L. F. FOGARTY, *Hon. Treasurer.*

Ruislip, Uxbridge.
*January 2nd*, 1923.

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### The Society of Technical Engineers.

Mr. Norman Wyld is welcome to whatever "encouragement" he may have derived from my remarks upon the S.T.E. in your last week's issue. A perusal of his lengthy apologia—for such it seems—gives one the impression that he stands in need of some stimulant of that nature. There is about his laboured effort to vindicate the merits and successful progress of the society he directs a curious vagueness—a suggestion of half-lights and wavering shadows—of blurred and indefinite outlines—so that the effect irresistibly reminds one of the grey monochrome of twilight.

Now there are normally two periods of twilight—that which precedes the dawn and that which heralds the approach of night. It is sincerely to be hoped that the former, and not the latter, has supplied the inspiration for the picture.

To judge by Mr. Wyld's careful evasion of most of the points of my criticism and by the general tone of his reply, it would seem that the reasons I suggested as possibly accounting for the slow progress of the society were not so very wide of the mark. From the nebulous prolixity of the letter before me there may be drawn several fairly well-defined deductions. One is that all is not well with the S.T.E. at the moment. Another is that the depressing blight of the uninspiring "policy," evolved some eighteen months ago, still envelops the society with its chilling breath. (I remember being at the time strongly reminded of the parallel of the mountain being in labour and bringing forth a mouse.) A third is that, so long as the present tactics are pursued there is little hope of vigorous growth and development of the S.T.E. in the near future.

It is all very well to aspire to hitch one's wagon to a star. Unfortunately, stars are so very far away that there is a danger of getting the traces entangled with an asteroid or perhaps a comet, and being dragged in an eccentric orbit at the tail of some wanderer in space, the motion of which is unknown and incalculable. Better to select an object a little nearer at hand, even if it is less satisfying to ambition.

After all, the S.T.E., like the E.P.E.A. and other similar bodies, owes its formation to the fact that dissatisfaction with existing conditions had come to be realised, and consequently the necessity of organising for the purpose of amending and improving these conditions was at once apparent. No amount of high-brow dissertation on lofty aims can alter that fundamental basis of origin. I do not dispute that an element other than mere considerations of self-interest does obtain in the aspirations of such societies or associations, but discontent, "divine" or otherwise, provides the primary impulse. And the first step is obviously to organise into a body for collective bargaining. Progress, to be effective, must begin at the bottom. Fair conditions and adequate remuneration are essential if the best men are to be attracted to any particular industry, and there is little doubt that, were the S.T.E. to devote its energies more particularly, in the first place, to securing these objects instead of focusing its gaze exclusively upon celestial heights, it would be able to record a greater measure of success than it apparently can to-day.

Mr. Wyld appears to be too much obsessed by difficulties in this connection, and, after hovering timidly round the tempting blossom of problematical material benefit, settles with an almost audible sigh of relief upon the less distracting, if less honey-bearing, bud of non-contentious measures, such as an employment bureau and unemployment insurance and superannuation. Laudable objects indeed, but why shirk the other issue? He contends that the E.P.E.A. has had an easier task than his own society, for reasons which he sets forth at some length, and he contrasts the supposedly smooth and rose-decked path of the former with the rough and boulder-strewn road in front of himself.

I am quite prepared to concede greater difficulties in the case of the society, but surely such difficulties are not insuperable. The grading of technical engineers in manufacturing works, for example, is not so formidable a problem as your correspondent would have us believe. He asserts that the members of the E.P.E.A. were "easy to grade"; I doubt, however, whether he would find those who have engaged in the task so very ready to agree with this opinion. Still, it has been done, and I feel sure members of the S.T.E. could be graded also if the question were tackled energetically.

The letter winds up with an appeal for additional members. In the absence of a refutation of the figure I suggested I take it that the present membership of the society is about 2,000, and at or about this it remains stationary—if it has not even declined. Well, unless evidence is forthcoming of the admixture of a little more ginger into the work of the S.T.E. than has been apparent hitherto, I fear there is small prospect of any startling increase in numerical strength.

I am sincerely desirous of seeing the S.T.E. inaugurate a more vigorous policy and set about the task of organising the great mass of unorganised engineers within its purview in a much more businesslike manner. If it continue to drift along indefinitely there can be little doubt that, sooner or later, it will be in danger of finding the sword which it apparently wields so feebly, slip from its nerveless grasp, to be taken up and used by other and stronger hands.

*January 8th*, 1923. **Salvo jure.**

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### Improvement of Power Factor.

I have read Mr. Rogers's letter of the 31st, but do not think that the correspondence can be usefully carried any further.

Mr. Rogers does not surely expect manufacturers to quote for condensers through the medium of your columns, and I think the two cases referred to in my letter, in addition to what has already been written, should suffice to show Mr. Rogers that he has not a leg to stand on as far as the original statement he made at the I.E.E. is concerned; I say this in quite a friendly spirit. I should advise Mr. Rogers not to get up at an I.E.E. meeting and make statements which are detrimental to the interests of manufacturers and which he cannot substantiate.

It is certainly one way of drawing forth criticism, but, personally, when I make a statement I prefer to be able to back it up with something tangible.

**E. W. Dorey.**

London, *January 8th*, 1923.

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### The Duty of Engineers in Parliament.

In last week's issue of the ELECTRICAL REVIEW, there appears a letter signed "Critic" entitled "The Duty of Engineers in Parliament." "Critic" records that there are 52 members of the present House of Commons more or less directly associated with engineering, including eight trade unionists.

The point of the letter is to suggest that the 52 should form a committee for engineering construction, to promote industrial development, regardless of party.

The following extract from "Critic's" letter gives some little insight into the scope before such a committee: "It seems that in the application of practical science we are twenty years behind the times. And this is not the fault of our engineers nor our contractors. It is the fault of our Parliament and politicians. They have neglected to equip this country as a modern civilised state which ought to be fit to rank with Germany, the United States, Switzerland, Norway, Sweden, and Denmark, in the use of applied science."

Is "Critic's" suggestion not a sound practical first step towards the formation of an industrial Parliament? Modern

industry is the fabric of the modern world, and the fabric has developed into such a very complex structure, that the time has long since arrived when it should be controlled and developed by practical men. I think the practical industrialist realises this truth, but he has been too much absorbed in his particular practical work to consider its co-relationship with the whole fabric.

Now, however, as "Critic" suggests, we have a nucleus to build up a practical directing force to weave our fabric on scientific lines. Why not act?

Southampton, *January 2nd*, 1923. **John D. Troup.**

### Guaranteed Installation Work.

What appears a very strange thing is the lack of salesmanship as applied to electrical installations by the contractor.

The usual course appears to be that of simply affixing the name of the business to the premises, printing a few letterheads, and cards, perhaps the sending out of a few circular letters containing the bald statement that Messrs. So & So are now electrical contractors, and will be pleased to quote for any job going, and then sitting down and waiting. How much better would it be if these firms, whether old or new, were to adopt real aggressive selling methods. They could, in the first instance, decide to guarantee their work either for 12 months or two years, and a metal plate having the particulars of the guarantee would be attached to the consumer's dis-board. The adoption of a guarantee would ensure that only first-class material was purchased, and that first-class workmen were employed, with intelligent and thoughtful planning of work; the only part of the installation that would not be feasible to guarantee would be the lamps, not that they wouldn't last a year, but simply because they are an unknown factor. Some lamps have been known to last for seven years, others only the same number of weeks. A provision of the guarantee would be that the contractor had the right of testing and examining the installation once every three months, and whilst doing so, it would be as well, either to bring invitation cards for the consumer to call at his showrooms to inspect new accessories, &c., or, alternatively, illustrations of the same might be left. The person who carries out these periodical tests must be primarily a salesman, and be ever ready and watchful to suggest new devices for the consumer's comfort and benefit, whether he (the consumer) is a private householder or business owner; also, by leading questions, he could find out what new work was likely to be got in the district.

Further to guaranteeing the work, it is, of course, a necessity for the contractor to advertise that fact, and an announcement in his local papers is the most efficient method of doing so. An 11-in. or 5-in. double column, regularly used once or twice a week, will amply repay its cost.

The combination of good advertising, guaranteed workmanship, and efficient salesmanship, will in the course of time, build up a business for the contractor, and the industry in general, of such dimensions and power, that the handyman electrician and shoddy contractor will die a natural death.

Glasgow, *January 8th*, 1923. **A. McLeod Bisset.**

### London's Electricity Supply.

I was rather interested to read your Leaderette in this week's issue, and notice you repeat what has so often been said in connection with re-organisation of electricity supply, namely, "the variety of methods, systems, and prices" with the idea that they could be considerably reduced. I have yet to learn in what way the re-organisation of electricity supply is going to make any appreciable difference in this matter.

The Electricity Commissioners have emphasised on more than one occassion that the re-organisation which is taking place is in respect of generation, and that the distribution will remain as at present; except in a few cases, how then can there be much unification of systems of supply or prices charged to consumers? How can there be any unification of the 200-volt a.c. supply in West Ham with the 240 volts d.c. supply in East Ham and the 150-volt supply in Leyton, to quote three districts which adjoin, unless you advocate the wholesale scrapping of distributing systems?

Similarly, how can the conditions in West Ham apply to East Ham and Leyton, so that the retail prices to consumers are identical in every respect?

It is perfection which might be hoped for, but it is not possible at the present time, and even the elimination of "small and unprofitable stations" to which you refer cannot bring this about.

It is rather unfortunate that the technical Press should assist the lay Press by repeating such statements, which, whilst representing the state of affairs as now existing, lead one to believe that a radical change is coming when such is not the case.

The best fate for the capital station bogey is capital punishment—it would be a capital ending to a stunt which can only benefit the capitalist in the capital of England.

**F. W. Purse,**
*Engineer and Manager.*
Electricity Department.
County Borough of West Ham,
*January 8th*, 1923.

## BUSINESS NOTES.

**The "Electrical Review" Index.**—The Index to Vol. XCI of the ELECTRICAL REVIEW, which will shortly be printed, will be supplied only to those who specially apply for it through the post. To these it will be supplied for 6d. post free. Any reader or advertiser, at home or abroad, who requires a copy for binding, or for other purposes, is asked to make early application therefor to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, E.C.4.

**Bankruptcy Proceedings.**—BUSFIELD & Co., 6, Wilfield Street, late 215, Padiham Road, Burnley, electrical engineers.—The receiving order in this matter was made on November 9th on a creditor's petition. The statement of affairs shows gross liabilities of £432, of which £424 is expected to rank. The first meeting of the creditors was held recently at the Official Receiver's offices, 13, Winckley Street, Preston, when the case, being a summary one, was left with the Official Receiver as trustee of the estate. The following are creditors:

| | £ | | £ |
|---|---|---|---|
| Palmer, Riley & Co. ... ... | 125 | Whittaker Bros. ... ... | 56 |
| Pemberton, G. ... ... ... | 100 | W. G. Pye & Co. ... ... | 28 |
| Baxendale & Co. ... ... | 77 | | |

FRANCIS LEOPOLD PERRIN, 57, Wellingborough Road, Northampton, and 5, College Street, Northampton, electrical engineer.—The adjourned public examination of this debtor was held on January 2nd at the County Hall, Northampton. Debtor was questioned with reference to an amount of £73 which had been set down as a bad debt and which had eventually been settled for £8. After further questions, the case was closed.

A. SMITH (Smith & Gill), electrician, 57, Albion Street, Nelson.—First meeting, January 16th, at the Official Receiver's offices, Preston. Public examination, January 17th, at the County Court House, Burnley.

F. H. THOMAS and W. E. EVANS (Thomas & Evans), electrical engineers, Salubrious Chambers, Salubrious Place, Swansea.—Receiving order made January 4th on debtors' own petition.

W. DRYSDALE, electrician, 24, Paxton Street, Barrow-in-Furness.—Trustee, Mr. H. Mossop, 4 Ramsden Square, Barrow-in-Furness, released December 19th, 1922.

F. RIDGEWAY and T. TYNAN (Ridgway & Tynan), electrical engineers, 21, Bowling Old Lane, Bradford.—Trustee, W. Durrance, Official Receiver, 12, Duke Street, Bradford, released December 15th, 1922.

W. H. BORROWS, engineer and electrician, Werrington, Northampton.—First and final dividend of 4½d. in the £ payable January 17th at the Official Receiver's Office, 5, Petty Cury, Cambridge.

H. J. W. EMBURY and K. S. EMBURY (H. & K. Embury), electrical and mechanical engineers, 110 and 29, Queen Street, Newton Abbot.—First meeting, January 12th, at the Official Receiver's office, Exeter. Public examination, February 8th, at the Castle, Exeter.

**Company Liquidations.**—MAXIM LAMP WORKS, LTD.—Liquidator, Mr. H. E. Burgess, Senior Official Receiver, Carey Street, W.C., released December 11th, 1922.

T.B.S. ELECTRICAL CONSTRUCTION CO., LTD.—A meeting of members is called for February 12th at Broad Street House, E.C., to hear an account of the winding-up from the liquidator, Mr. F. C. Goodman.

**Dissolution of Partnership.**—SMITH & Co., electrical contractors, 4, Oakeswell Street, Wednesbury, and 165, Walsall Road, Darlaston.—Mr. R. L. Smith and Mr. H. Smith have dissolved partnership. Mr. R. L. Smith will attend to debts and continue the business.

**Trade Announcements.**—MESSRS. THOS. FIRTH & SONS, LTD., announce that the telegraphic address of their London office (8, The Sanctuary, S.W.1) has been changed from "Mesmeric, Vic." to "Mesmeric, Parl."

THE TRIUMPH ELECTRIC MANUFACTURING CO., LTD., of Birmingham, has appointed Mr. J. A. Sloane, of 49, Deansgate, Manchester, as its agent for the Manchester district, and Mr. R. F. Sunderland, of Milburn House, Newcastle-on-Tyne, as agent for the North-East Coast district.

ELECTRICAL INSTALLATIONS, LTD., of Martin Lane, Cannon Street, E.C., have acquired the electrical contracting business of Mr. S. D. Brand, Bridge Street, Guildford, and are opening a branch of their business in that town.

MESSRS. STARKIE & SPARKES, electrical engineers and contractors, have opened showrooms premises at Shaw (Lancs.).

THE STERLING TELEPHONE AND ELECTRIC CO., LTD., has opened a branch at 14, St. Peter's Square, Manchester (telephone: "City 7035"), under the management of Mr. W. Blogg, to meet increased business in several counties. Stocks of telephonic and radio apparatus will be kept and demonstrations given there.

THE G. & P. ELECTRICAL Co. has opened a new branch at 194, Alfred Street Central, Nottingham, under the management of Mr. A. A. Brown.

MR. FREDERICK PRATT, 23, Queen Anne's Gate, S.W.1, has been appointed sole British representative of the N.V. Electriciteits Maatschappij Electrostoom, of Rotterdam.

MESSRS. TODMAN, RYALL & Co., LTD., of 38, Grosvenor Gardens, London, S.W.1, state that having made considerable extensions to their business, they are now able to supply generators, a.c. and d.c., from .1 to 1,000 kW; motors, a.c. and d.c., from ½ to 500 h.p.; repulsion induction type, from 1 to 16 h.p.; alternators and transformers, up to 500 kVA.

MR. CHARLES D. PHILLIPS, of 26, Dock Street, Newport, announces that having made arrangements to join the firm of Charles D. Phillips, Ltd., of Emlyn and Central Engineering Works and Foundries, Newport, Mon., founded by his late father some 55 years ago, he has decided to retire from his auctioneering practice, and will be taking up his new position with the firm very shortly.

**Catalogues and Lists.**—MESSRS. E. W. FARROW & SONS, Spalding, Lincs.—List No. 36, giving an illustration and full details of small steam-driven electric lighting sets (1-kW), consisting of Robey vertical engines coupled to generators by Electromotors, Ltd. These sets are useful in steam launches, or in other situations where surplus steam is available.

THE BRITISH THOMSON-HOUSTON Co., LTD., Rugby.—Price Lists No. 5,021, drum type controllers and resistances; No. 5,022, reversing drum type controllers and resistances; and No. 7,312, crystal receiver for "broadcasting." Also Descriptive List No. 3,210, dealing with d.c. switchboard panels for pressures up to 660 V. All lists are well illustrated.

RADIO INSTRUMENTS, LTD., 12, Hyde Street, New Oxford Street, W.C.1.—An illustrated list giving details of cabinet sets for the reception of radio "broadcasting," &c. Fully priced. Also a coloured showcard advertising the firm's radio apparatus.

THE ENGLISH ELECTRIC Co., LTD., Queen's House, Kingsway, W.C.2.—Publication No. 340, an illustrated list of electrical winding plant installed or in course of erection.

MESSRS. ADAM HILGER, LTD., 75a, Camden Road, N.W.1.—An illustrated pamphlet describing an interference accessory for testing microscope stands and fine adjustments.

THE LONDON FACTORS & AGENTS, LTD., 38 & 39, Parliament Street, S.W.1.—January net trade price list of electrical accessories and materials, including accumulators, bells, cable, conduit, fuse boards, switchgear, &c.

THE EMBASSY MANUFACTURING Co., 21a, Upperhead Row, Leeds.—An illustrated and priced folder dealing with the "Embassy" vacuum cleaner.

MESSRS. HOLLINGS & GUEST, LTD., Thimble Mill Lane, Birmingham.—Two priced and illustrated lists of hydraulic presses for numerous purposes.

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI, 56, Victoria Street, S.W.1.—January list (in French) of motors and dynamos in stock.

MR. ASHTON BREMNER, 16, Green Street, Trafalgar Square, W.—An illustrated booklet dealing with horn-gap lightning arresters manufactured by La Métallurgique Electrique, for which firm Mr. Ashton Bremner is sole representative.

MESSRS. MELDRUMS, LTD., Timperley, Manchester.—New catalogues and lists of forced draught furnaces, mechanical stokers, and the Meldrum oil burner.

**Calendars and Diaries.**—THE LEA RECORDER Co., LTD., 28, Deansgate, Manchester, has sent us a desk memoranda block for 1923 with ample daily space for engagements or notes.

A wall calendar with a block of daily date slips with large red figuring has been received from the ELECTRICAL CONTRACTING & MOTOR Co., of Townend, Pontefract.

A desk calendar received from the BRITISH EBONITE Co., LTD., of Hanwell, London, W.7, contains half-a-dozen two monthly cards, each bearing a humorous picture indicating the correct thing to do under given circumstances.

A large wall calendar has reached us from the BRITISH THOMSON-HOUSTON Co., LTD., of Rugby. It is in the form to which we have all become accustomed. Each monthly sheet contains also the preceding and the following months' dates.

From the *Chemical Trade Journal* we have received a wall calendar with monthly sheets.

MR. ALLAN E. BARNES, of 4, Park Street, Keighley, sends a small wall calendar, "An Eastern Beauty," forming the pictorial attraction.

MESSRS. W. H. SUGDEN & Co., LTD., Glenny Road, Barking, Essex, have issued a wall calendar with monthly sheets on which engagement space is left for every day.

THE DAVENPORT ENGINEERING Co., LTD., of Harris Street, Bradford, has sent us a wall calendar with daily tear-off slips for 1923.

MR. J. MARTIN BLAIR (Heemaf Co., Amberley House, Norfolk Street, Strand, W.C.2) is sending out a pocket diary for 1923, in which illustrations of representative manufactures are included.

From MR. O. S. PUCKLE, of 1, Epping New Road, Buckhurst Hill, Essex, a wall calendar has come to hand.

THE UNIVERSITY ENGINEERING COLLEGE of Westgate-on-Sea, Kent, has sent us a neat and acceptable pocket wallet for our notes, season ticket, and stamps.

A somewhat similar wallet has also been issued by MESSRS. SUPERLAMP, LTD., of 111, Great Eastern Street, London, E.C.2.

From MESSRS. HASLAM & STRETTON (Engineering and Motor Utilities, Ltd.), of 11, Windsor Place, Cardiff, we have received a wall calendar with monthly date slips. Cosily befurred "Eva," the pictorial feature, will ensure it a prominent place on many a wall.

THE D.P. BATTERY Co., LTD., of Bakewell, Derbyshire, have sent us a calendar with monthly slips, and as usual its attractive feature is a view of the beautiful surroundings in which the works are set. The River Wye, from which the motive power for the D.P. works is obtained, runs through the famous Derbyshire Dales, and the coloured view, when seen from a proper level, demonstrates how admirably the works harmonise with the charming scenery.

THE LIVERPOOL MARINE AND GENERAL INSURANCE Co., LTD. (the office issuing a "wireless" policy), has sent us a handy vest-pocket diary for 1923, with just enough space in its several sections to make one strive after neatness in making entries.

**The Engineering Section at Wembley Exhibition.**—In the ELECTRICAL REVIEW for August 11th, 1922, p. 193, we published the names of the members of the Electrical Committee (B.E.A.M.A. members and co-operating members) for the British Empire Electrical Exhibition.

We now publish the names of those who are serving on the General Committee nominated by the British Engineers' Association who, it will be remembered, are responsible for the shipbuilding, marine, mechanical and general engineering section.

| | |
|---|---|
| Harry Allcard | (Easterbrook Allcard & Co., Ltd.) |
| Harry Allcock | (W. T. Glover & Co., Ltd.) |
| S. E. Alley | |
| Col. O. C. Armstrong, D.S.O. | |
| Duncan G. Bailey, O.B.E. | |
| Herbert Ballard | |
| Stanley J. Benham | (Benham & Sons, Ltd.) |
| Claude T. Berthon | (Pott, Cassels & Williamson) |
| R. A. Blakeborough | (J. Blakeborough & Sons, Ltd.) |
| J. D. Brunton | (Messrs. Bruntons) |
| H. M. Butler | (Kirkstall Forge Co., Ltd.) |
| Lt.-Col. E. Kitson Clark | |
| Basil T. Courtney | (Joshua Buckton & Co., Ltd.) |
| Col. Percy B. Crowe | |
| J. E. Durbishire | (Hydraulic Engineering Co., Ltd.) |
| Sir John Dewrance | (Dewrance & Co.) |
| C. E. Douglas | (Douglas & Grant) |
| Sir Arthur M. D. Duckham, K.B.E. | |
| D. N. Dunlop | (British Electrical & Allied Manufacturers' Association) |
| Fredk. C. Fairholme | (Thos. Firth & Sons, Ltd.) |
| L. M. G. Fraser | (W. F. Fraser & Sons) |
| Arnold Gamble | |
| Eng. Vice-Adml. Sir Geo. G. Goodwin, K.C.B. | |
| Neville G. Gwynne, C.B.E. | (Gwynne's Engineering Co., Ltd.) |
| Wm. Hay Howden | (Jas. Howden & Co., Ltd.) |
| F. E. Howard | (Hayward-Tyler & Co., Ltd.) |
| Jas. H. Humphreys | (Braithwaite & Co. Engineers Ltd.) |
| Arthur Jacob | (British Aluminium Co., Ltd.) |
| J. R. C. Kearns | (H. W. Kearns & Co., Ltd.) |
| Col. H. P. Lawson | (Cole, Marchent & Morley, Ltd.) |
| Fredk. H. Livens | |
| A. Ernest Owen | |
| Ernest W. Petter | |
| W. B. Richardson | (Richardson, Tuer & Co., Ltd.) |
| Robert S. Rowell | |
| Capt. H. Riall Sankey, C.B., C.B.E. | |
| Sir Wilfred Stokes, K.B.E. | |
| Sir John E. Thornycroft, K.B.E. | |
| Lt.-Col. F. W. Turner | |
| Douglas Vickers, M.P. | |
| A. Vines | (Eversbed & Vignoles, Ltd.) |
| Gilbert C. Vyle | |
| Herbert J. Ward | (J. & E. Hall, Ltd.) |
| Brig.-Genl. C. H. Whittington, C.M.G., C.B.E. | (Mather & Platt, Ltd.) |
| E. Wilson | (General Electric Co., Ltd.) |

**Railway improvements and extensions arising out of the British Empire Exhibition at Wembley include the construction of a new loop line and station within the grounds, and the enlargement of three or four other neighbouring stations.** Work on the new loop line has been started by the Great Central Railway. This line, between Neasden and Wembley Hill, will run into the exhibition grounds and out again without the necessity of a dead end, so that passenger trains can follow each other quickly. The new exhibition station on the loop line will be within the grounds of the exhibition. It is expected to be able to deal with 16,000 passengers an hour at this station. Good progress has already been made with the extension of Wembley Park Station on the Metropolitan line.

**The Gothenburg Tercentenary.**—The Municipality of Gothenburg has sent us a pamphlet announcing the intention to hold a jubilee exhibition in connection with the celebration of the tercentenary of the city's foundation. At this exhibition the Swedish export industry will receive full opportunities to display its scope. The exhibition will run from May 8th to September 30th.

**For Sale.**—By direction of the Disposal Board, Messrs. King & King will sell by auction on February 1st and following days at H.M. Dockyard, Portsmouth, machinery, plant, electrical equipment, &c.

Marylebone Borough Council Electricity Department invites offers for four 500-kW Parsons-type direct-coupled turbo-generators. (See our advertisement pages to-day.)

**Japanese Trade.**—The trade outlook in Japan is one of promise, and during the past year trade has not been at all bad. A tour of the country has shown that there is a growing tendency on the part of manufacturers to do direct export business rather than rely upon the services of export houses. Japan is taking a greater interest in electrical machinery and is making rapid progress in the uses to which she is placing electricity. Though in the country there are large manufacturers of electrical goods, and though Japan exports large quantities of these goods to China, there is little doubt that for the higher class manufactures she is dependent upon Western nations, and British goods are very favourably received. The one great drawback the British merchant has to face is either his inability or disinclination to appoint agents or to send representatives out who are qualified to handle the goods they represent.—*Reuter's Trade Service* (Tokio).

**Christmas Entertainment.**—The children of the employés of the Birmingham Electric Supply Department were entertained at the Midland Institute on December 28th and 29th by a performance of "Cinderella." The entire caste was composed of children of employés of the Birmingham Tramways Department, under the direction of Conductor J. H. Fletcher, the result of whose work in training the children was, we are informed, highly successful. Excellent scenic effects were obtained, reflecting credit on the skill of Inspector Peach and Motorman Orton. The entertainment was organised by the Whitley Works Committee of the Electric Supply Department.

**E.D.A. Activities.**—The Electrical Development Association is not content to merely urge the use of electricity for cooking, but also instructs users how this should be done. To this end it has recently published a booklet (E.D.A. 297) containing a hundred recipes for dishes of all kinds, compiled by Mrs. C. A. Mole, M.C.A. In addition, information regarding cookers is given. "20th Century Cookery," as the booklet is called, can be obtained from the E.D.A. at the price of 1s. per copy; a discount of 10 per cent. is allowed for quantities in excess of one dozen.

**Book Notices.**—"Water Power in the British Empire" (pp. 54). London: Constable & Co., Ltd. Price 3s. 6d. net.—This small but comprehensive volume contains the reports of the Water Power Committee appointed by the Conjoint Board of Scientific Societies under the chairmanship of Sir Dugald Clerk, K.B.E. (who contributes a preface). Prof. A. H. Gibson, D.Sc., who acted as secretary to the Committee, has prepared the reports for publication. There have been three of these reports, and each was reviewed in our columns about the time of its publication.*

"*Mechanical World* Year Book, 1923" (pp. 348+215 (advt.) and diary). London and Manchester: Emmott & Co., Ltd. Price 1s. 6d. net.—The principal additions to the latest issue of this useful handbook are in connection with ventilation, humidification, mechanical draught, &c. The section dealing with safe loads and deflections of beams has been re-written and new illustrations are included. Among other revised and extended sections is that on belting.

The City Librarian of Coventry has sent us a copy of a publication which we believe to be a new departure in public library service. This is a bibliography of works on radio telegraphy and telephony with which the Coventry libraries appear to be well equipped. Sir William Noble has contributed a note in which the importance of the art is emphasised.

Technologic Paper No. 223, "Reclamation of used Petroleum Lubricating Oils" (5 cents); Scientific Papers No. 446, "Spectrophotoelectrical Sensitivity of Argentite ($Ag_2S$)" (5 cents); No. 447, "Theory, Construction, and Use of the Photometric Integrating Sphere" (10 cents); and No. 450, "An Electron Tube Amplifier using 60-cycle Alternating Current to supply Power for the Filaments and Plates" (5 cents). (U.S. Bureau of Standards). Washington: Government Printing Office.

"Pitman's Radio Year Book for 1923" (first year). Pp. vii +148, illustrated. London: Sir Isaac Pitman & Sons, Ltd. Price 1s. 6d. net.

"The Philosophy of Management" by O. Sheldon. Pp. xvi+296; figs. 8. London: Sir Isaac Pitman & Sons Ltd. Price 10s. 6d. net.

"Scientific Management and the Engineering Situation"—Sidney Ball Memorial Lecture—by Sir W. Ashley. Pp. 28. London: Oxford University Press. Price 1s.

Reid's Handy Colliery Guide and Directory for the Counties of Northumberland, Durham, Yorkshire, Cumberland, and Westmorland. Newcastle-upon-Tyne: A. Reid & Co., Ltd. Price 3s. 6d.

* ELEC. REV., August 16th and 23rd, 1918 (pp. 151 and 189). ELEC. REV., August 29th, 1919 (p. 264). ELEC. REV., November 11th, 1921 (p. 657).

**Annual Dinner.**—The indoor and outdoor staffs of Messrs. Francis Polden & Co., Ltd., with a number of friends, held a very successful dinner and social evening at the Mecca Restaurant, Ludgate Hill, on Saturday last. The dinner, which was excellently arranged, was followed by a short toast list, the toast of "The King" being followed by "The Chairman and Company," proposed in a felicitous speech by Mr. W. J. Revell, and briefly responded to by Mr. Francis C. Polden in the same vein. Mr. W. T. Smith humorously replied to the toast of "The Ladies and Visitors," proposed by Mr. A. C. Hill. The final toast was that of "The Indoor and Outdoor Staffs," proposed by the managing director, Mr. Francis Polden. The friendly relations existing between the management and the staff were manifested both by the speech and its reception by the assembled company.

A subsequent concert rendered by the "Oursisit" concert party displayed both originality and versatility, and the many items were well received.

**Lead.**—In their report dated January 6th, Messrs. James Forster & Co. state:—"The demand for immediate lead since the holidays is distinctly slack, but there is no alteration in the intrinsic position of the metal, the consumption of which is good and increasing, without any evidence of increased supplies."

**Lead Prices.**—Messrs. M. H. Cawson & Co., of 60, Gracechurch Street, London, E.C.3, have issued a large diagram showing the monthly average market prices of soft foreign pig lead from 1912 to the end of 1923, with space left for 1923 fluctuations to be filled in as they occur.

**New Use for a Shop-Window Heater.**—The Midland Electric Power Installation Co. informs us that the "Mepic" electric shop window heater, to which we referred in a previous issue, is now being used for warming ink rollers on printing machines, and the result is stated to be exceedingly satisfactory. This seems to indicate a fresh and useful outlet for this apparatus.

**Reduced Prices.**—THE ASTER ENGINEERING CO., LTD., of Wembley, has reduced the prices of its electric lighting plants.

**Siemens and English Electric Developments.**—There has been issued to the trade notification of the reconstruction of the company previously trading under the title of English Electric & Siemens Supplies, Ltd. As in the case of the old company, the principal shareholders of the new company are Messrs. Siemens Bros. & Co., Ltd., and the English Electric Co., Ltd., and they have agreed to transfer their lamp manufacturing interests at Dalston and Preston respectively to the new company. The consent of the Board of Trade has been given to changing the name of the company, and as from January 1st, 1923, the company trades under the title of Siemens & English Electric Lamp Co., Ltd., with registered offices at Caxton House, Westminster, S.W.1.

The sale of electric lamps and various supplies will be carried on from 38/39, Upper Thames Street, London, E.C., and from the various branches as heretofore. The Siemens and English Electric Lamp Co. will control both the manufacture and sale of Siemens lamps in the future, and by arrangement will operate as the sales organisation for supplies and material manufactured by Messrs. Siemens Bros. & Co., Ltd., and the English Electric Co., Ltd. This includes Siemens wires and cables, Stannos wires and accessories, Zed fuses, wireless apparatus, telephones, instruments, &c. The board of directors consists of the following gentlemen:—Mr. P. J. Pybus, C.B.E., chairman (managing director of the English Electric Co., Ltd.); Mr. G. Chauvin (managing director, Siemens Bros. and Co., Ltd.); Mr. W. O. Smith (director of Siemens Bros. and Co., Ltd.); Mr. V. Watlington (The English Electric Co., Ltd.); Dr. H. Wright (Siemens Bros. & Co., Ltd.); with Mr. F. Hird (general manager of Siemens Bros. & Co.) as managing director; Mr. A. M. Hicks has been appointed secretary. The new company has adequate manufacturing plant and land for extensions to meet the continually increasing demand for lamps and other material above specified. No change has been made in the trading addresses, and customers will be dealing with the same executive staff as heretofore.

**To Provide Work for Those Who Fought.**—Mr. Arthur Willey, M.P. for Central Leeds, writing to *The Times*, suggests that Empire Overseas authorities, when they have competing tenders before them and find among them attractive offers from manufacturers in foreign countries, they should find out whether the British firms whose tenders are before them are on the King's Roll, and therefore almost certainly employing a certain percentage of disabled men. He asks for such a circumstance to be allowed to weigh as a decided factor in their favour, as it is quite possible that such employment militates against production at the lowest price. The point is perhaps of greater importance than is sometimes recognised, but it is really only one of the many reasons why we should develop our trade relations within the British Empire to the utmost of our power.

**Instructions for Installing Electric Cookers.**—THE JACKSON ELECTRIC STOVE CO., LTD., has sent us a card bearing instructions for the installation of its electric cookers, and also a list of directions for the use of these in various classes of cooking.

**Aiding the Retailer.**—In addition to their deferred-payment plan in connection with the larger electrical domestic appliances, MESSRS. L. G. HAWKINS & CO., LTD., have instituted several new schemes to keep and encourage the retailer in the sale of their appliances. The prices of these have been reduced and retailers can apply for and receive back the difference between the prices paid for appliances in stock and the new prices. To popularise the "Miller" portable lamp, Messrs. Hawkins are giving a table stove with each one sold. They also offer to renovate articles that have deteriorated while in stock at half the cost to themselves.

**British Catalogues Wanted in Chile.**—According to H.M. Chargé d'Affaires at Santiago, Chile, Chilean Government Departments are kept well supplied with American and Continental firms' catalogues, calendars, photographs, &c., but only meagrely with those of British manufacturers. We suggest that our machinery and apparatus firms should repair this defect. Government Departments, when calling publicly for tenders, are influenced by the catalogues that are at hand, especially if they are printed in Spanish and contain metric weights and measures. Inquiry at the Department of Overseas Trade in London would be worth while.

**Time Switches Commended.**—At the trials of apparatus for municipal use held last year at Cardiff by the Institution of Municipal and County Engineers, the time switches manufactured by the Horstmann Gear Co., Ltd., of Bath, were "highly commended."

**Czecho-Slovakian Trade.**—Last year 113 new limited companies were founded in Czecho-Slovakia, with a capital of £6,000,000. In ten months about 100 large firms failed, with total liabilities of nearly £6,000,000, while 1,435 firms sought a judicial settlement of their liabilities, says the Carlsbad correspondent of the Exchange.—*Evening News.*

**French Import Duty Reduction.**—A slight reduction in the coefficient of increase in the import duty in France and Algeria on insulating cloth and oiled silk for electrical purposes (ex. 439) has just been announced by the French Customs authorities.

**Electrolytic Iron in Spain.**—In 1916 the Chamber of Commence of Madrid petitioned the Spanish Government to obtain leave from England for the importation of electrolytic iron, needed for the national industries. This article was the product of Spanish iron ore. The English Government was obliged to return a refusal on account of the necessities of the war. On the Spanish side, this situation has now been permanently retrieved by the building by the Sociedad Espanola de Construcciones Electro-meccanicas of electrolytic works at Cordoba, for the treatment of native ore. The works when started will be capable of a yearly output of 4,000 tons, to be raised later to 8,000, 12,000 and 18,000 tons, as needs demand, thus freeing Spain from foreign dependence for this product.

## LIGHTING AND POWER NOTES.

**Accrington.**—LOAN.—The Corporation has decided to apply for sanction to borrow £9,000 in connection with the supply of electricity to Oswaldtwistle.

**Australia.**— ROCKHAMPTON (QUEENSLAND).— Arrangements have been made to borrow £70,000 by debentures for an electrification scheme in the town.—*Reuter's Trade Service* (Melbourne).

BATHURST (N.S.W.).—The City Council is taking steps to borrow £40,000 for the installation of electric light in the town. —*Reuter's Trade Service* (Melbourne).

**Barrow-in-Furness.**—LOAN SANCTIONED.—The Town Council has received sanction from the Electricity Commissioners to a loan of £19,000 for electricity purposes.

**Beer and Seaton.**—ELECTRICITY SUPPLY.—Steps are being taken to obtain a supply of electricity for the district. Sufficient capital has been promised to justify the formation of a company to carry out a scheme.

**Birkenhead.**—LOAN.—The Electricity Committee has recommended the Council to apply to the Electricity Commissioners for sanction to borrow £20,000 for the purchase and laying of electricity mains and service cables.

**Birmingham.**—PRICE REDUCTIONS.—The Electric Supply Committee recommends a revision of the charges for electricity purposes. It is recommended that for electric signs for advertising purposes the rate be 3d. per kWh; for ordinary lighting (under 1,000 kWh per quarter), 5½d. per kWh; factory lighting, 4½d. per kWh, and prepayment meters, 5½d. per kWh.

**Bradford.**—LOAN SANCTIONED.—The Electricity Committee has received sanction from the Commissioners to the borrowing of £6,200 in respect of the laying of new e.h.p. and d.c. feeders from Bolton Road sub-station to Nelson Street.

**Canada.**—NEW BRUNSWICK.—The contract between the City of St. John and the New Brunswick Electric Commission for a minimum of 10,000,000 and a maximum of 15,000,000 kWh of electricity per year from the Provincial Development Commission was signed on November 24th by representatives of the city and the commission. As the recent outcome of the refusal of the New Brunswick Power Co. to sell its entire plant and equipment at a price of $2,577,655—the sum set by the Supreme Court in 1920—the Common Council in committee decided to recommend to the Council the establishment of a civic Hydro Commission, as authorised in the New Brunswick Electric Power Act, which will serve for a term of two years.

QUEBEC.—A scheme is in progress for the utilisation of Lake St. John for generating electricity. A dam is to be built at the Grand Discharge from the lake at a cost of $12,000,000. It is proposed to develop 1,200,000 h.p. and to provide power for the entire province of Quebec, with a surplus to be transmitted to New England factories.

BRITISH COLUMBIA.—The British Columbia Electric Co., in addition to improvements in its power plant on the Stave River, is planning the construction of a new power house further down the river, to cost $10,000,000. It is estimated that the new plant will develop 100,000 h.p.—*Reuter's Trade Service* (Vancouver).

**Cannock.**—LOAN SANCTIONED.—The Urban District Council has received the sanction of the Electricity Commissioners to the borrowing of £7,978 for electricity extensions at Hednesford and Chadsmoor.

**Clowne.**—ELECTRICITY SUPPLY.—Steps are being taken to form a local company with the object of carrying out an electric lighting scheme for the town.

**Derby.**—PRICE REDUCTION.—The Town Council has reduced the percentage charge for electricity supplied on the rateable value system from 15 to 12½ per cent. as from January 1st.

**Dewsbury.**—PRICE REDUCTIONS.—The Corporation is reducing the charges for electricity from 7½d. to 7d. per kWh for lighting, and for power on the maximum demand system from 100 per cent. to 80 per cent. above pre-war charges, the reductions to operate from the meter readings in the current quarter.

**Dover.**—PROPOSED EXTENSIONS.—The Town Council is seeking the advice of a consulting engineer on two schemes for increasing the facilities for the supply of electricity. One involves the addition of a 1,250-kW turbine set at an estimated cost of £37,000, and the other provides for the erection of a new power station at an estimated cost of £90,000. The Electricity Commissioners have intimated that they would sanction the former scheme subject to Dover linking up its supply with the Folkestone electricity works, each town laying the cable half way. Negotiations are proceeding for the supply of electricity to Deal.

**Glasgow.**—PURCHASE OF ELECTRIC COOKERS.—The manager of the electricity department has reported to the Corporation Electricity Committee that out of 400 electric cookers purchased 397 had been hired out, and it was agreed to recommend that an additional 200 cookers be purchased.

ELECTRICITY *v.* GAS.—The Electricity and Gas Departments of the Corporation have come into conflict in the matter of cooking apparatus. It is stated that canvassers from the Electricity Department have persuaded tenants of several of the Corporation's houses to replace their gas cookers by electric ranges, but in certain instances these tenants have been dissatisfied and have asked for the return of the gas cookers, causing great inconvenience to both departments. To prevent this in future it has been resolved not to permit any further changes until the consent of the manager of the City Improvements Department has been obtained.

**Halifax.**—ELECTRICITY SUPPLY.—In order to provide work for the unemployed the Unemployment Grants Committee has decided to lay new cables at a cost of £8,832.

**Hull.**—PRICE REDUCTIONS.—The Electricity Committee has reduced the charge for electricity for lighting from 8d. to 7d. per kWh, and for power from 120 per cent. to 75 per cent. above pre-war charges.

**Kilmarnock.**—YEAR'S WORKING.—The accounts of the burgh electricity undertaking (engineer: Mr. W. C. Bexon) for the year ended May 15th, 1922, record a total income from all sources of £103,080, comparing with £125,101 in 1920-21. Working expenses amounted to £66,559, as against £92,201, leaving a gross profit of £36,521 (£32,900). Capital charges increased from £29,394 to £46,571, causing a net deficit of £3,087, as compared with a profit of £5,235 in the previous year. A total of £147,265 was spent on capital account during the year, the principal items being: Mains, £59,131; machinery and boilers, £42,014; and buildings, £21,643. The number of kWh sold decreased from 16,777,388 to 14,411,975. During the year the length of 22,000-V overhead lines was increased from 1.51 to 5.96 miles, and the number of transformer sub-stations from 70 to 81. The plant capacity remained at 10,000 kW.

**Lewes.**—STREET LIGHTING.—The Town Council has asked the Electric Light Company to prepare a scheme for lighting the streets of the town, and to submit a price.

**Liverpool.**—LOAN.—The Electricity and Tramways Committee has recommended that application be made to the Electricity Commissioners for sanction to the borrowing of

£250,000. It is proposed to purchase the Liverpool District Lighting Co.'s undertaking at a cost of £75,000, and to lay underground mains at a cost of £175,000.

**Llandrindod Wells.**—APPLICATION FOR ORDER.—The Urban District Council is making application to the Electricity Commissioners for authority to generate and supply electricity for all purposes within the urban district, and to provide for the transfer to the Council of the electricity undertaking of the Llandrindod Wells Electric Light & Power Co., Ltd.

**London.**—HACKNEY.—*Proposed Price Reductions.*—At a meeting of the Council this week Ald. H. Morrison, L.C.C., moved that the Electricity Committee be asked to consider and report upon the question of reducing the prices charged for electricity.

**Maidstone.**—LOANS.—The Town Council has applied to the Electricity Commissioners for sanction to the borrowing of £3,862 for transformers and switchgear, £4,158 for mains, and £1,051 for buildings in connection with the extensions to Snodland, Tovil, and Cherry Orchard Estate.

**Manchester.**—CONVERSION OF STATION.—The Electricity Committee recommends that an early start be made with the conversion of the Dickinson Street station from a generating station to a transforming sub-station. The Committee believes that it can make an annual saving of £5,000, equal to 11 per cent. of the outlay involved.

SHOP-WINDOW ILLUMINATION.—The Electricity Committee, anxious to encourage advertising by illumination, contemplates providing means for its development. It is proposed to offer a special inclusive rate of 1½d. per unit for shop-window illumination after closing hours. A profit is expected to be made.

**Newton Abbot.**—SPECIAL ORDER.—Mr. Raymond Hartree, of Salcombe, has informed the Rural Council that he is applying for a Special Order to enable him to supply electricity in the Council's area.

**Rochdale.**—ELECTRICITY IN BULK.—In response to applications from the Urban District Councils of Milnrow, Whitworth, Littleborough, and Norden, the Corporation has intimated that it is prepared to give the districts a bulk supply of electricity at a charge of 0.35d. per kWh.

**Rotherham.**—PRICE REDUCTIONS.—The Town Council has reduced the charges for electricity for manufacturing purposes from 100 per cent. above pre-war price to 75 per cent., and for power for tramway purposes from 1.8d. to 1.6d. per kWh.

**Southampton.**—EXTENSION OF SUPPLY.—As a result of negotiations with the Eastleigh Urban District Council, the Town Council has applied to the Electricity Commission for authority to supply electricity in that area. The cost of the extensions is estimated at £26,672. Romsey Borough Council has also asked for a supply.

**South-West Midlands Electricity District.**—A Bill to confer further powers upon the Shropshire, Worcestershire and Staffordshire Electric Power Co. has been deposited for introduction into Parliament next Session. The company is responsible for the electrical development of portions of the counties of Salop, Stafford, and Worcester. In order to perform these duties the company is about to erect the generating station authorised in 1918 on the Stourport site as part of the separate undertaking recently constituted under the name of "The Severn Main Power Supply." For the development of the separate undertaking and for the purpose of providing additional facilities for the conveyance of coal and material to the Stourport station the company proposes to acquire land and to construct a short railway from a wharf on the Staffordshire and Worcestershire canal to the Stourport generating station and a railway siding connecting with the Severn Valley branch of the Great Western Railway. The cost of these works is to be defrayed out of money to be raised by the issue of Severn Electric Power Supply shares or debenture stock. In order to give full effect to the recent order of the Electricity Commissioners the powers of the company are to be extended so as to enable it to supply electricity direct to the consumers in a large area in the three counties at a maximum rate of 1s. per kWh. Power is sought to pay interest not exceeding 7½ per cent. per annum out of capital on securities issued after December 31st, 1921, for five years from the date of issue, provided that the aggregate amount paid does not exceed £62,500. A similar proposal is made with regard to interest on money borrowed, the aggregate amount paid not to exceed £125,000.—*Financial Times.*

**Ulverston.**—ELECTRICITY IN BULK.—The Urban Council has had under consideration a proposal to obtain a supply of electricity in bulk from the Corporation works at Barrow-in-Furness, and has appointed Mr. C. H. Wordingham, C.B.E., to advise on the scheme.

**United States.**—LARGE POWER PROJECT.—The Byllesby Engineering and Management Corporation announces a new electrical, water, and steam power construction and development programme for Minneapolis and St. Paul, involving an estimated expenditure of $80,000,000. The new construction, which will extend over a period of about ten years, will increase by about 306,000 h.p. the generating capacity of the Northern States Power Co. This concern serves 350 cities and towns in Minnesota, the Dakotas, Wisconsin, Illinois, and Iowa, and is one of the operated properties of the Standard Gas and Electric Co.—*Reuter's Trade Service* (New York).

**Wanstead.**—ELECTRICITY SUPPLY.—The Walthamstow Urban Council proposes to apply for powers to enable it to supply electricity to Wanstead.

**Wolverhampton.**—PRICE REDUCTIONS.—The Corporation has reduced the charges for electricity for lighting, power, and general supplies from 90 per cent. above the pre-war rate to 75 per cent.

**Yeovil.**—ELECTRICITY SUPPLY.—With reference to the application being made by the Yeovil Electric Light & Power Co., Ltd., for an Order to supply electricity, the Rural Council has applied to the Ministry of Transport, asking that the area of supply should include Preston Plucknett and Yeovil Without.

## TRAMWAY AND RAILWAY NOTES.

**Argentina.**—RAILWAY ELECTRIFICATION.—A commencement will shortly be made upon the electrification of the Argentine Transandine Railway, permission having been given by Congress for the raising of the necessary loan of 1,500,000 (gold) pesos, over and above the sum already allotted, to be used for the electrification of the system between Zanjon and the Chilean frontier. The length of this section is 45 km., and, when completed, the section will connect up with the section of the Chilean State line now being electrified.—*Reuter's Trade Service.*

**Australia.**—NEWCASTLE (N.S.W.).—The State Government has set aside a sum of £100,000 in the current year's estimates for the electrification of the tramways. The work will be completed in two years. On the present system of steam operation a loss of over £70,000 per annum has resulted, but it is estimated that a reduction of one-third in the working costs will be made when the system is electrified.

**Bolton.**—NEW ROUTE.—The Town Council has decided to extend the Brownlow Fold tramway to Harpers Lane.

**Bradford.**—LOAN SANCTIONED.—The Tramways Committee has received sanction from the Ministry of Transport to the borrowing of £63,000 to cover the cost of 46 new cars and £104,925 for the reconstruction of track in parts of Bolton Road, Wakefield Road, Great Horton Road, Horton Park Avenue, Birkenshaw Church Bank, and Thornton and Lidget Green. Track renewals on the Nab Wood section of the tramways were commenced on January 8th.

LOAN.—Application is being made to the Ministry of Transport for sanction to the borrowing of £85,500 for extensions to the Thornbury car depôt and workshops.

**Brighouse.**—RAILLESS CARS.—The Town Council has decided to support the Bradford Corporation's application for authority to run railless cars beyond the city boundary.

**Continental.**—SPAIN.—An early start on the electrification of the Vascongados Railways is contemplated. The system consists of 158 km. of narrow-gauge line.—*Reuter's Trade Service* (Madrid).

NORWAY.—The electrification of the Christiania-Drammen Railway has been completed as far as Brageroen, and it is anticipated that the new service will come into use during the present month.

**Leeds.**—PROPOSED NEW ROUTE.—The City Council has applied to the Ministry of Transport for an Order authorising the construction of a tramway to Templenewsam.

**London.**—NEW TYPE OF "TUBE" COACH.—In order to evolve an improved type of coach for the "tube" railways, the London Electric Railway Co. recently invited five of the principal railway-carriage and coach-building firms in the country to construct a sample coach. Among the firms selected were Messrs. Cammell, Laird & Co., Ltd., who recently held a private exhibition of the vehicle, built at their Nottingham works. The coach is designed on the motor saloon-car principle. There are no straight edges anywhere, and the wheels are fitted with leather shrouds to deaden the noise in the tubes. An important departure is in the lighting. Those lamps which show are of cut glass, while the rest are so concealed as to avoid casting a glare in the eyes of "strap-hangers" or other passengers. The sliding doors are worked by air pressure. The furniture and fittings are more luxurious than anything at present seen on the "Underground." Royal blue and ivory in enamel are the prevailing decorative colours. The upholstery is in Royal blue and old gold. The fittings are of aluminium and black vulcanite. Seating accommodation is provided for 48 passengers.—*The Times.*

**New Zealand.**—AUCKLAND.—The City Council is extending its tramway system to Edendale at a cost of £69,700.

**Peru.**—PROJECTED IMPROVEMENTS.—An extensive contract has been entered into between a group of Italian capitalists and the Empresas Eléctricas Asociadas de Lima (Peru) for the entire reorganisation and partial reconstruction of the electric light and street railway systems belonging to that company. The systems controlled by this organisation comprise (*a*) the Ferrocarril Urbano de Lima (length 33 km.), in the capital, which carries between 17 and 18 million passengers annually; (*b*) Tranvías Eléctricas de Lima y Chorillos, an electric light railway 33 km. in length, operating in connection with the Lima tramways; (*c*) Ferrocarril de Lima y Callao, a light railway 15 km. in length; (*d*) the Compañia Nuéva Tranvía Eléctrica (Lima-Chorillos-Herradura); and (*e*) the Empresa Eléctrica de Santa Rosa, supplying the necessary current to all the above undertakings. The additional capital to be found will exceed £1,000,000, the greater part of which will be devoted to railway projects. While a considerable proportion of the new equipment will be purchased in Italy, foreign contractors are not excluded from tendering.—*Reuter's Trade Service* (Lima).

**Portsmouth.**—TRACK RENEWALS.—The Town Council has applied to the Ministry of Transport for sanction to the borrowing of £193,000 for track renewals in the borough.

## TELEGRAPH & TELEPHONE NOTES.

**Greenland.**—RADIO STATIONS.—Several months ago the Danish Government sent an engineer to Greenland to examine the possibilities of establishing radio stations in that Danish colony. He has now returned and advised the establishment of four stations. It is expected that three will be established on the west coast and one on the east coast, near Angmagsalik, the latter in response to a special request from the Government of Iceland, which declares that a station there will be of the greatest importance in transmitting weather information to Iceland.—*The Times.*

**India.**—RADIO-TELEPHONY.—Some progress has been made in the installation of the radio telephone in the Moplah tracts of Malabar and a few sets have been installed and messages transmitted and received.—*Indian Engineering.*

**Norway.**—BROADCASTING SCHEME.—The Norwegian Radio Co., the Norwegian Marconi Co., and the Norsk Telegram Bureau have submitted to the Government a request for a concession to build and carry on a broadcast telephone system from stations in Norway. It is said that the companies intend to form a joint broadcasting telephone company for the purpose of building sending stations in Christiania, and subsequently at Bergen and Trondhjem, each with a radius of one hundred miles, for the regular transmission of concerts. Receiving apparatus, for hire by subscribers at an annual fee, will be placed under the control of the telegraph board. The companies have also requested Government leave to build a large radio-telephone station in Christiania in order to broadcast Press exchange news and weather forecasts over the whole of Southern Norway. Radio-telegraphy is intended to be used for long distances, such as Trondhjem and the North Cape.—*The Times.*

**Radio-Telegraphy.**—EMPIRE SCHEME.—According to *The Times*, a deputation from the Empire Press Union invited the Postmaster-General on January 8th to make a statement of the Government's policy with regard to an Empire wireless system.

The schemes which have been set on foot in Australia, Canada, and South Africa for direct communication with Great Britain mean that the Imperial chain as originally planned is not likely to develop. Australia has made a contract with a private company in which the Australian Government holds a majority of the shares; South Africa has given a concession to the Marconi Co.; and Canada has licensed the Marconi Co. of Canada to erect a high-power station at Montreal. New Zealand has also expressed herself in favour of a high-power system giving world communication rather than the chain system.

The Empire Press Union demands an adequate Imperial system, whether it is the outcome of private or public enterprise. The view taken is that the system in contemplation by the Post Office is neither adequate nor efficient. The Government is approaching the whole question afresh, and a Cabinet committee has been appointed, under the chairmanship of Mr. Amery, and the question of communication with the East African colonies was also raised.

The Postmaster-General (Mr. Neville Chamberlain) replied sympathetically to the deputation. According to the *Daily Telegraph*, he pointed out that on what was a technical subject the technicians were not in complete agreement. The Government was reconsidering the late Government's policy, but "Who shall find the money?" was a question about which a conclusion had not yet been come to, but he did not think a decision would be very long delayed; they could not allow the thing to drag on. It was not solely a matter of the number of messages that could be dealt with; they must also consider what was to be the extra capital cost of any luxury they allowed themselves, and whether the prospects of the traffic to be obtained would justify them in going the full length at once. It was not proposed to include communication with Canada by the same station as that which would communicate with Australia. The working day of the station in England would be divided into periods, one period being devoted to communication with one part of the world, and another period with another part, always choosing the periods so as to coincide with that part of the day when atmospheric conditions were most favourable.

With regard to the West Indies, the difficulty was not one of radio telegraphy, but of the insufficiency and disrepair of the existing cable. He was glad to say that inquiries had been made for a new cable.

**Radio-Telephony.**—BROADCASTING.—Since the New Year, a third broadcasting station has commenced operations on behalf of the British Broadcasting Co. It is located at Newcastle-on-Tyne, is known as station "B," and has a power of 1,500 watts, with a wave-length of 400 metres, its call signal being 5 N O.

The Birmingham station's call signal is now 5 I T.

An improvement has recently been made in the aerial at the London station, which has increased its range.

The most interesting demonstration in this country up to the present of the possibilities of broadcast telephony was arranged for January 8th, when parts of the British National Opera Co.'s performance of Mozart's "Magic Flute" at Covent Garden were radiated from the London station of the British Broadcasting Co. The demonstration was successful and selections from operas will be broadcast nightly until the conclusion of the present Covent Garden season, says *The Times.*

A special underground cable has been laid between Covent Garden Opera House and the London broadcasting station in the Strand for the purpose of these transmissions.

According to the *Morning Post*, there is every likelihood that two further broadcasting stations will be in working order by the end of this month. They will be Cardiff, which may be ready within the next week, and Glasgow, which may be opened about the 25th inst.

The opening of these two stations will bring the number operating to six out of the eight contemplated.

An effort is to be made to broadcast a little each Sunday, out of which a regular programme will probably develop in which church sermons will be a feature.

**Russia.**—RADIO-BROADCASTING. — Radio-broadcasting has started at Moscow under the direction of the radio-telephone station of the National Commissariat of Ports. The first speech to be broadcast was addressed to the All-Ukrainian Congress of Soviets, at Kharkoff. As far back as September 19th, 1922, a radio concert was successfully arranged in Moscow, but the Bolsheviks have been slower than was expected to utilise the latest inventions for propaganda.—*Daily Mail.*

**Spain.**—TELEPHONE SERVICE.—The Spanish Government has lately granted a concession for the establishment of a telephone exchane in the town of Plasencia (Province of Caceres).

**The Telephone Service.**—CALDER VALLEY.—A start has been made with the transference of telephone wiring in this district from overhead to underground, and the work is proceeding from Sowerby Bridge to Mytholmroyd.

NEW ANGLO-DUTCH CABLE.—Owing to the fact that three telephone lines between Holland and England have proved insufficient for the great number of demands, the Dutch Telegraphic Directorate has entered into negotiations with the British for the laying of a new cable of high capacity.—*Financier.*

**Turkey.**—TELEGRAPH CONTROL.—The Angora Government has decided that Adnan Bey shall henceforth act as delegate at Constantinople of the Commissariat of Foreign Affairs of the Grand National Assembly of Turkey. He will negotiate the handing over to Turkish control of the posts and telegraphs, the cable of the Eastern Telegraph Co., and of the Constanza cable requisitioned by the French military authorities.—*Reuter* (Constantinople).

**West Indies.**—RADIO-TELEGRAPHY.—Arrangements are being made by the local Government for the sending of messages to ships in the harbour of Port of Spain, San Fernando and Brighton, and for the captains of such ships to communicate with their agents in Port of Spain. It has also been decided to establish a receiving station at North Post, which will do all receiving work, the Tobago traffic, and ship work. The Port of Spain station, which will be the controlling or head station and the one with which alone the public will deal, will thus be left free for long-wave work with Venezuela, British Guiana, St. Martin, Curaçao, &c. Communication between North Post and the head station will be maintained by the existing telephone line and also radio. A scheme for linking the telephone systems of Tobago and Trinidad by radio is also likely to be inaugurated.—*Financier.*

# ARMOURCLAD SWITCHGEAR.

## A Visit to the Works of Messrs. A. Reyrolle & Co., Ltd., Hebburn-on-Tyne.

In the complicated aggregate of machinery, apparatus, and cables which has been evolved to meet the demands of our still more complex civilisation for a supply of electricity, the switchgear occupies a position analogous to that of the nerves and spinal cord in the human organism—the place of honour, not indeed the brain itself, but the means whereby the organism is controlled, and the various organs are caused to function at the will of the brain. Hence the operation of the whole system depends upon the adequacy of the switchgear for its purpose and the facility and certainty with which it responds to the calls that are made upon it; above all, it must be reliable under all circumstances. Moreover, it is at this point that the human controller of the great electrical machine most closely approaches the powerful agency of which he is normally the master, but which, given the opportunity, will utterly destroy him; hence it is, literally, vitally necessary that the switchgear shall be so constructed as to deny to that grim agency the chance of breaking its bonds and wreaking its blind fury upon the puny mortal who has created it. These chief considerations—immunity from breakdown and safety to the operator—over-ride all others, even that fetish, the lowest tender, and have continually gained in importance as the magnitude of the undertakings and the pressures employed have increased. Those of us who remember the station "switchgear" that was in vogue in the 'eighties have witnessed an extraordinary process of evolution from the primitive appliances that did duty in those days to the elaborate apparatus that is indispensable to the conduct of modern power stations and systems of supply.

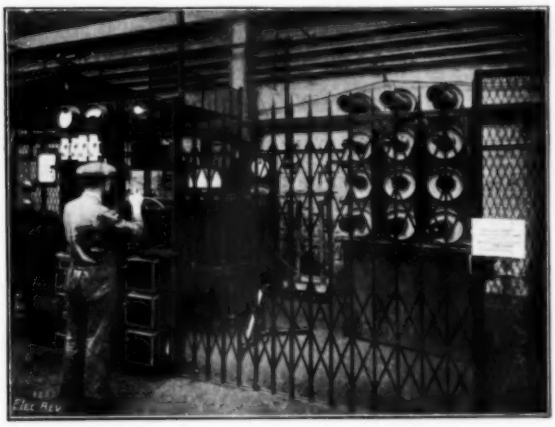


Fig. 3.—Part of the Test-Room; 33,000-V Switch under Test.

Fig. 1.—Heavy Assembly Shop, for 33,000-V and M-type Switchgear.

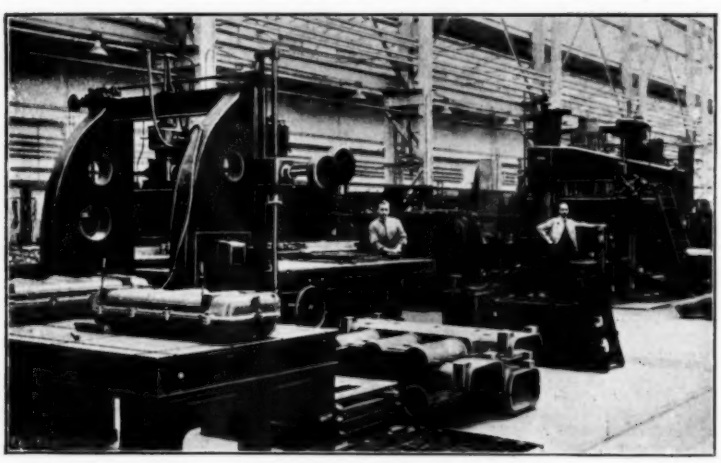


Fig. 2.—Planer-Milling Machine, and Radial Drill.

The wall-type switchgear introduced by Dr. S. Z. de Ferranti about 1896 effected a revolution in a.c. switchgear, and for many years was almost without a rival, except the air-break type—also a Dept-

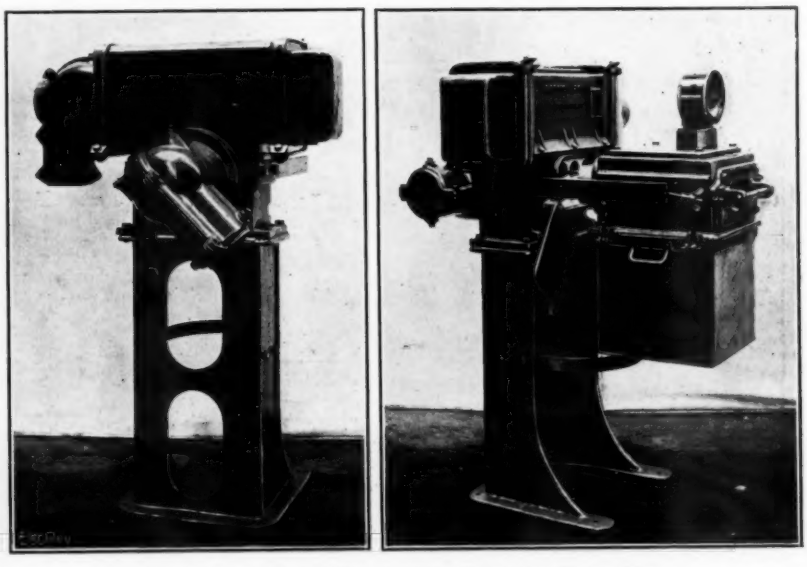
ford product—which was installed sometimes. But the tendency in this country was mainly towards direct current at moderate pressures, and the further development of high-pressure a.c. switchgear largely took place abroad, until the inevitable adoption of three-phase generation and distribution to sub-stations here also compelled attention to the subject.

Since then a remarkable division of opinion has arisen. All were agreed as to the necessity of interrupting a.c. circuits carrying large powers at high pressures, under oil; but whilst the majority of switchgear designers continued to rely upon wide spacing of bus-bars, &c., in air for protection against short-circuits, and upon remote control for the safety of the operator, one firm—Messrs. A. Reyrolle & Co., Ltd.—struck out on original lines, holding the view that close spacing with solid insulation, from which air was as far as possible excluded, better met the former requirement, and that complete enclosure in protective armour effectually complied with the latter. This practice obviously follows that of cable manufacture, in which, indeed, it is pushed to the limit; for we enclose three conductors at a potential difference of 33,000 V within a lead sheath three inches in diameter, surrounded by steel armour, and bury them, confident that miles of such cable will give satisfaction and safety for years to come.

Working on these lines, Messrs. Reyrolle enveloped their bus-bars and connections in cast-iron jackets and filled up the internal space with a bituminous compound. This class of construction essentially calls for compactness in order to economise material; it is inherently robust and durable, but owing to the necessity of making connections which must

FIG. 4.—MINING SWITCHGEAR ASSEMBLY SHOP.

FIG. 5.—WORKSHOP PLUG AND SOCKET.



FIGS. 6 & 7.—MINING SWITCHGEAR, BACK AND FRONT VIEWS.

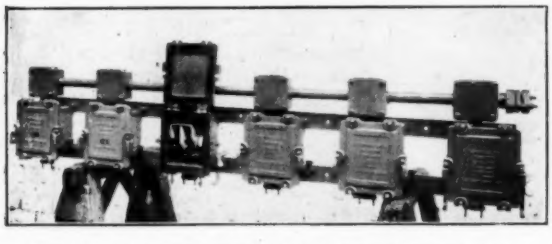


FIG. 8.—EXPLOSION-PROOF 30-A CIRCUIT-BREAKERS FOR DANGEROUS SITUATIONS.

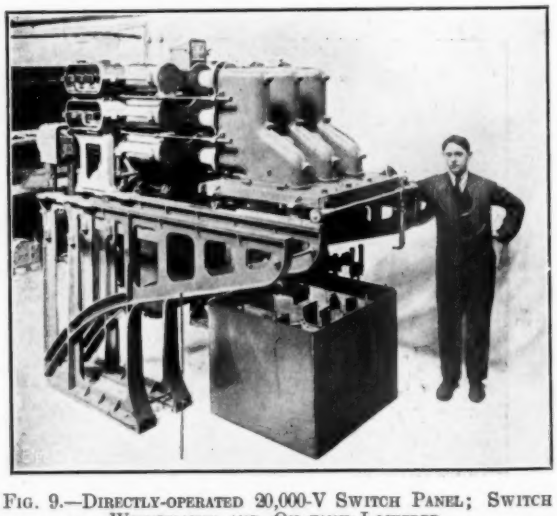


FIG. 9.—DIRECTLY-OPERATED 20,000-V SWITCH PANEL; SWITCH WITHDRAWN AND OIL-TANK LOWERED.

be opened or changed from time to time, it might not possess the essential element of safety. However, by the aid of ingenious devices which guard against every conceivable eventuality, Messrs. Reyrolle have fulfilled this requirement as effectually as the others, and are in a position to claim that their switchgear is as safe as it is reliable.

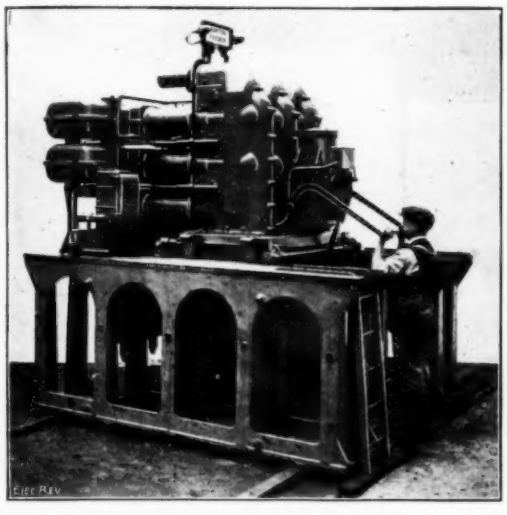


Fig. 10.—Solenoid-operated 33,000-V 400-A Duplicate-busbar Draw-out Switch Panel, Type $R_1$, Switch Racked Home; Operator Closing It.

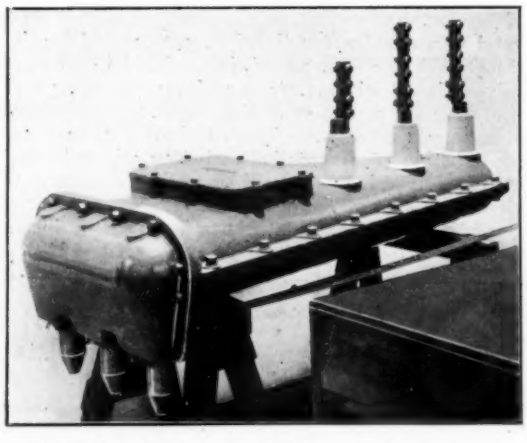


Fig. 11.—Armourclad Terminal for Alternator.

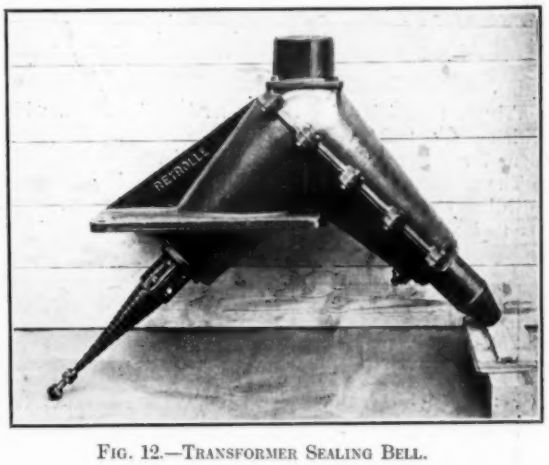



Fig. 12.—Transformer Sealing Bell.

It is interesting to note that Messrs. Reyrolle's works, where this entirely British type of switchgear has been evolved, are situated on Tyneside, the birthplace also of another purely British product, which has revolutionised power-station practice throughout the world—the Parsons steam turbine. The site occupies an area of over 5½ acres, of which at present 3½ acres is covered with workshops and offices. The main building is 200 ft long by 200 ft. wide, and is divided into five bays, each 40 ft. wide, which are served by overhead cranes of 5 and 15 tons lifting capacity. A railway track runs into the centre and side sections. The equipment includes a planer-milling machine, fig. 2, with a table 13 ft. 6 in. long and 5 ft. wide, capable of handling castings up to 15 tons, and driven by a 24-h.p. motor. The machine shop contains a large number of lathes, drills, shapers, slotting machines, grinders, &c.; amongst items of special interest are a tool for drilling square holes, a large double-spindle vertical drilling machine with a radius of 7 ft., capable of drilling holes up to 3 in. in diameter, and a grinding machine 16 ft. long, which is used to face up surfaces such as the steel top plates of switches, and the faces of joints on castings forming the chambers for busbars, switch panels, sealing bells, &c.; this grinder has a wheel 52 in. in diameter, with inserted carborundum segments dovetailed in position, and is driven by a 30-h.p. motor. The large shop illustrated in fig. 1 is devoted to switchgear assembling, both of detailed parts and of complete panels.

Fig. 3 shows part of the high-pressure testing section, which is 120 ft. long and 40 ft. wide; this section is served by a 5-ton overhead crane, and is fenced off. Arrangements have now been completed for providing an entirely new testing laboratory in which will be installed a transformer supplied at 5,500 volts from the supply company's mains through an induction regulator with which the primary voltage can be varied from 0 to 11,000 volts, whilst the secondary voltage correspondingly varies from 0 to 450,000 volts. At the time of our recent visit, tests were being carried out on an impulse discharge device which had been assembled for the purpose of testing lightning arresters; it consisted of a 250,000-volt transformer which charged a 0.15 mF condenser through a kenotron rectifying valve. The condenser, discharging into a highly inductive circuit, gave an oscillatory discharge at about 115,000 cycles per second, the current being about 4,000 A, which corresponded to a momentary maximum output of 168,000 kVA. Pressures up to 85,000 volts can be used, giving a discharge of 8,400 amperes, corresponding to 700,000 kVA, which is probably equivalent to that induced in about 4,000 ft. of line by a lightning flash.

Immediately adjoining the main building is a packing department, into which a railway track is run, the packing floor being served by an overhead crane having a lifting capacity of 5 tons.

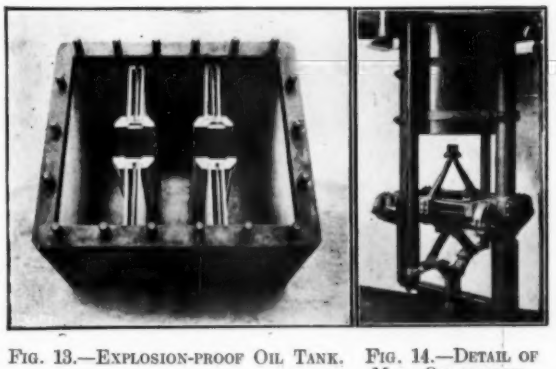


Fig. 13.—Explosion-proof Oil Tank. Fig. 14.—Detail of Main Oil-switch and Sparking Tips.

At the north-west side of the site is a two-storey building, 242 ft. long by 40 ft. wide by 42 ft. high. The upper storey is reserved as an insulating and transformer department and also for the production in large

quantities of plugs and sockets up to 30 amperes' capacity, and other small repetition work. The ground floor is arranged for the fitting and assembly of mining type switchgear, and at one end of this shop is a section in which varnishing, black enamelling, and stoving is done, fig. 4. By a recent extension, the space between this building and the main building has been roofed over,

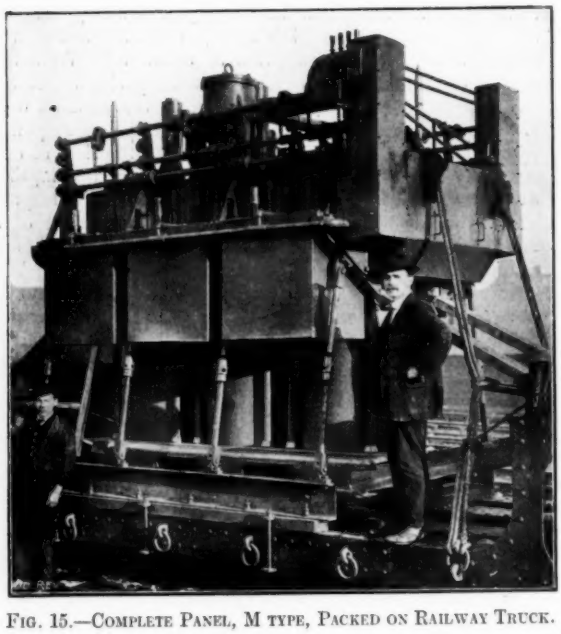


FIG. 15.—COMPLETE PANEL, M TYPE, PACKED ON RAILWAY TRUCK.

making an additional shop 242 ft. long by 25 ft. wide, which will permit of the provision of a separate department for the erection of control boards.

The pattern makers' and joiners' shop is a separate building one storey high, 120 ft. long by 40 ft. wide. Its tool equipment includes planes, band saws, lathes, circular rip saws, &c., with the modern form of drive from motors fitted in a trench beneath the machines.

A few small shops cover an area of about 30,000 sq. ft.; these formed the original works, and are now used partly as stores and partly for light machine-tool work.

The offices, which have recently been extended by 7,000 sq. ft. area, are roomy, well lighted both by daylight and artificially, and are heated by hot-water radiators, provision being made in the wiring system for electric fires. The drawing office covers an area of 5,800 sq. ft.

The electric power is supplied to the works by a three-phase feeder at 6,600 volts from the system of the Newcastle Electric Supply Co. This feeder is brought through Reyrolle sealing bells into a 270-kW transformer of the outdoor type, situated in the open yard. The

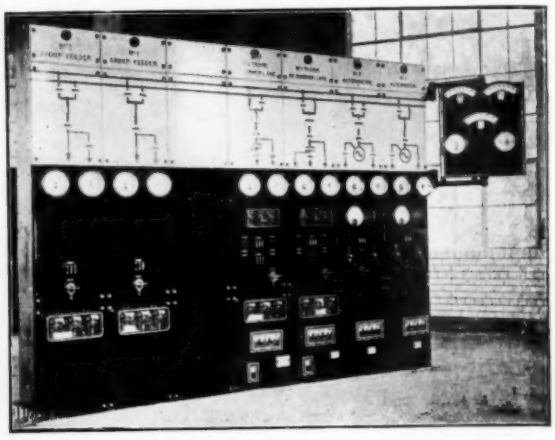


FIG. 16.—SEVEN-PANEL CONTROL BOARD, M TYPE SWITCHGEAR.

total consumption for lighting, power, and heating is 2,900 kWh per day, part being utilised in an electrically-equipped kitchen, from which meals are provided daily for the workmen and the staff.

A tour through the shops makes it clear that the construction of armourclad switchgear is a branch of heavy engineering; this will be realised from an examination of some of the accompanying figures, representing switches of the largest dimensions recently installed.

FIG. 17.—VIEW UNDER FEEDER SIDE.

FIG. 18.—VIEW UNDER BUSBAR SIDE.

M TYPE SWITCHGEAR AT DALMARNOCK.

But all through the wide range of apparatus that we saw in course of manufacture the same principles are observed—namely, meticulous accuracy in the dimensions and assembly of the metal parts, and equally painstaking care in the application of the insulating

materials, of which porcelain, bakelite, bakelised paper, and varnished cloth were the principal factors. The precision with which the conductors and insulators were assembled and fixed in exactly the right positions in the cast-iron casings, with the aid of jigs, was a particularly noticeable feature of the work; it is, of course, imperatively necessary owing to the rigidity of the structure and to the requirement that all units of the same pattern must be strictly interchangeable and must fit together in banks without adjustment on site. This is especially important in view of the exportation of Reyrolle switchgear, which is being installed in Canada, Australia, South Africa, New Zealand, India, China, and elsewhere—including the European Continent—on an increasing scale; in this connection it is interesting to note that, thanks to the standardisation of details and precision of method, the company has been able to undertake manufacturing in Australia, much of the Reyrolle switchgear installed in the Perth power station of the Government of West Australia having been manufactured by Australians in their own country. The 66,000-volt Merz-Price current transformers in connection with the protective interlinking system of the Gennevilliers power station were purchased from Messrs. Reyrolle & Co.

Another notable feature of the switchgear is its specially designed adaptability to extension by simply adding panel to panel without limit, the plant being at all times complete in itself. Each item is fully equipped with interlocking gear, mainly mechanical, and practically immune from failure to function. Electrical interlocking, however, is used wherever called for by the circumstances, as, for instance, where it is desired to interlock a bank of switchgear with a section switch at some distance.

From the nature of its design, metal-clad apparatus is essentially compact, occupying only about half the space required for the cubicle type. It is made in a remarkably wide range of sizes and patterns—the smallest being suitable for lamp circuits, &c., not only in workshops, but also for domestic uses; we illustrate in fig. 5 a plug and socket, with a hook for the former, which can quite well be used without a separate switch. The F type, illustrated in figs. 6 & 7, is specially adapted for colliery work, where it has met with a large demand, both for underground and for surface work, being simple, explosion-proof, robust, and safe; this gear is made for capacities up to 100 A at 6,600 V, or 400 A at 3,000 V. It is not, however, restricted to mining applications, being suitable for use wherever explosive gases are present. For distribution switchgear in factories, &c., the U type is provided, of which an example is given in fig. 8. Limits of space forbid our dwelling upon other intermediate types of switchgear. Turning, therefore, to the heavier apparatus, we illustrate in fig. 9 a 20,000-V directly operated armoured draw-out switch panel, with the switch withdrawn and the oil-tank lowered for the inspection of contacts. It will be noticed that when the switch is in this position, iron flaps cover the live contacts, so that not even a rat could gain access to them. The ends of the duplicate bus-bars can be seen at the back of the gear, and on the top is an automatic indicator showing which set of bars is in use.

Fig. 10 shows a 400-A 33,000-V duplicate bus-bar armoured draw-out switch, type R 1, for solenoid operation; the switch has been racked home, and is being closed by hand. Switches of this type have been installed by Manchester and Birmingham Corporations. The oil tank of an R-type switch is shown in fig. 13; it is of heavy boiler plate, capable of withstanding an internal pressure of 300 lb. per sq. in., and is lined with plywood. The R type has a rupturing capacity ranging from 150,000 kVA to 1,000,000 kVA at 33,000 V.

Largest of all these panels is the M type, installed at Birmingham, Glasgow, Manchester, and Carville; this has a rupturing capacity from 1,500,000 to 2,000,000 kVA at 33,000 V. One of these switches is shown on a railway truck in fig. 15, by which its great size may be gauged. Even more impressive are the views reproduced in figs. 17 and 18, showing the galleries under the switchgear at Dalmarnock, Glasgow; the latter is roofed in by the bus-bar connections, whilst the former shows the feeders leaving the switchgear. In these panels the current passes from the bus bars to the split-conductor feeder by way of the bus-bar selector switch, the main oil switch, and the cable isolator switch. The bus bars are heavily taped and embedded in compound; the connecting conductors are similarly taped or fitted into bakelite tubes, and run in with compound. After the main switch contacts have opened, the current passes round a complete turn through the spark tips, and the magnetic field thus formed helps to blow out the arc; a detail view of this device is given in fig. 14. The main circuit breaker is operated by a solenoid at 250 volts from the control room. The selector switches are interlocked so that only one set can be in commission at once, and they are electrically interlocked throughout each section. The oil tanks are also mechanically and electrically locked. Even the switch-house crane is unable to obtain current unless the switch over which it is working is dead. The mechanical and electrical interlocks have been worked out with marvellous ingenuity and thoroughness, so that, it is claimed, mistakes cannot be made. In addition to these precautions, means are provided to keep the switching operators informed exactly as to the actual state of the system at any moment. In fig. 16 will be seen, above the control board, a diagram symbolically representing the switchgear and connections; the switch symbols are mounted on disks which automatically rotate through a right-angle when the corresponding switches are closed or opened, indicating at a glance the connections that have been made or broken.

Messrs. Reyrolle & Co.'s interest is not confined to switchgear; their methods apply to many other features of electricity supply and distribution. For instance, fig. 11 shows a box designed to connect three single-core lead-covered cables from the switch panel to the terminals of an 11,000-volt, 50-cycle, 16,500-kVA, three-phase generator. The live parts are entirely armour-clad. Part of the box is made of non-magnetic material, and the cable glands (which are of the Universal type) are insulated from the main casting in order to avoid circulating currents in the lead sheaths of the cables. This design of terminal joint box is due to the Yorkshire Electric Power Co.

The question of installing switchgear and transformers out of doors has also received their attention. Fig. 12 shows a compound-filled right-angle type 20,000-V sealing bell for mounting on the top of the extension of a transformer tank. This forms a pocket extending below the oil level, and the conductor and bakelised paper insulator of the bell dip into this pocket. The flange bolts on to the top of the transformer tank, and the body of the bell takes away a single-core lead-covered cable through a universal brass gland and wiped lead joints at a suitable angle.

An interesting experiment is in progress at the works, a standard indoor switch being exposed to the weather with no protection save a rough iron screen. This switch is kept alive at 5,000 volts, and so far has shown no sign of distress. This is hardly surprising, in view of the construction of the apparatus, in which the worst conditions are allowed for; switchgear intended for use at 33,000 V is tested to 150,000 V.

Messrs. Reyrolle & Co. now employ 1,100 persons, and produce on the average 140,000 kW of armourclad switchgear every week. That their policy has justified itself is evident from these facts. Much more could be said regarding their products, but space fails us, and we must conclude with an expression of thanks to Mr. H. W. Clothier, his co-directors, and the company's staff for the courtesies extended to us on the occasion of our visit.

# CONTRACTS OPEN AND CLOSED.

*(The date given in parentheses at the end of the paragraph indicates the issue of the* ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

## OPEN.

**Australia.** — MELBOURNE. — Postmaster-General's Department. January 17th. Telephone and telegraph apparatus. January 24th. Testing and telegraph instruments. February 22nd. Switchboard parts. March 1st. Telephone and telegraph parts. (December 22nd.)

Electricity Commissioners. March 31st. Transformers for Morwell power scheme. (January 5th.)

March 15th. Motors, starting and isolating switches. (See this issue.)

April 28th. Transformers and spares. (See this issue.)

PERTH (W.A.).—March 1st. Government Tender Board. L.p. switchgear.*

**Belfast.**—January 23rd. Electricity Department. One 12,500-kW turbo-alternator, with condensing plant and auxiliaries, three 500-kW rotary converters with transformers, l.p. switchgear, &c. (January 5th.)

January 30th. Electricity Department. One electrically-driven centrifugal pump, 18,000 g.p.m. (See this issue.)

**Belgium.**—January 30th. Municipal authorities of Hasselt. Establishment of a system of h.p. and l.p. underground distribution mains in the town, together with an overhead l.p. distribution system. Specification (35 fr.) from the Bureaux du Secretariat Communal, Hasselt.

February 10th. Municipal authorities of Tournai. For the concession for the supply of h.p. current for public and private purposes in the town. Particulars from the Service des Travaux, 58, Rue Saint-Martin, Tournai.

**Dundee.**—January 19th. Electricity Department. House service meters. (January 5th.)

E.h.p. and l.p. 3-core armoured cable. (See this issue.)

**Eastbourne.**—February 10th. Electricity Department. Coal-suction conveying plant. (See this issue.)

**Egypt.**—ALEXANDRIA.—January 17th. Ports and Lighthouses Administration. Stores, including electrical goods, for 12 months.*

CAIRO.—March 15th. Minister of the Interior. Supply of electrical fittings for 12 months. Director, Personal and Equipment Department, Ministry of the Interior, Cairo.

**Glasgow.**—The Corporation Electricity Committee has authorised the manager to obtain tenders for additional water-screening plant required at Dalmarnock power station.

The Corporation is inviting offers for the electric lighting installation of the Pollokshaws housing scheme. Specifications from the electrical engineer.

**Gravesend.**—January 30th. Electricity Committee. One draught-tube water-tube boiler and accessories. (See this issue.)

**London.** — CAMBERWELL, S.E.—February 5th. Borough Council. Maintenance of private telephones and electric bells at the Town Hall and other public buildings for 12 months. Mr. F. J. Slater, borough engineer, Town Hall.

BERMONDSEY. — January 29th. Electricity Department. Stores for six months, including cable and jointing material, conduits, meters, electrical accessories, &c. (January 5th.)

ISLINGTON.—January 31st. Electricity Department. Electrical and engineer's stores for 12 months, including cables, meters, transformers, electrical sundries, &c. (January 5th.)

ST. GEORGE'S-IN-THE-EAST.—January 25th. Board of Guardians. Installation of electric lighting in the infirmary, Raine Street, E. (See this issue.)

**Manchester.** — February 12th. Electricity Committee. 33,000- and 6,600-V switchgear and resistances. (See this issue.)

**Newcastle-on-Tyne.**—January 16th. Tyne Improvement Commissioners. One 20-h.p. and three 3-h.p. d.c. electric motors. Specification from Mr. Richard Aughton, general manager.

**Newport (Mon.).**—January 22nd. Electricity Department. One marine-type water-tube boiler, with superheater, economiser, stokers, steam and feed-water pipes, &c. (January 5th.)

**New Zealand.**—INVERCARGILL.—January 31st. Southland Electric Power Board. Outdoor transformer station equipment for the Monowai hydro-electric development scheme.*

**Oldham.**—The Finance Committee is inviting tenders for the electric winding and lighting of the clock in Oldham church tower, instead of the complete electrification of the clock.

**Sidmouth.** — January 29th. Urban District Council. Electric lighting scheme. Erection of buildings; plant, including oil engine-driven dynamo, motor booster, switchboard, accumulators, overhead traveller, &c.; overhead mains, house services, &c. (January 5th.)

**South Africa.**—JOHANNESBURG.—February 8th. Municipal Council. Tramway spares.*

**Stockton-on-Tees.**—January 24th. Electricity Department. Supply of 4-core paper-insulated, lead-covered wire-armoured cable. (See this issue.)

**Uruguay.**—MONTE VIDEO.—February 15th. State Electricity Works. 16,000 metres of coloured cords for internal wiring.*

February 9th. 27,750 metres of 225-V, v.i.r. lead-covered cable.*

*A copy of the plan, specification, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Room 84), 35, Old Queen Street, S.W.1.

## CLOSED.

**Bradford.**—Tramways Committee.

20 tons cast-iron track brake blocks (£240).—National Rail and Tramway Appliances Co., Ltd.

Manganese steel crossings for Bingley Road and Saltaire junction (£611).—Hadfields, Ltd.

Electricity Committee.

Two 300-kVA transformers; two 600-kVA transformers.—Hackbridge Electric Construction Co., Ltd.

Two 300-kVA transformers.—Metropolitan-Vickers Electrical Co., Ltd.

Two 300-kVA transformers.—British Electric Transformer Co., Ltd.

Two 200-kVA transformers.—English Electric Co., Ltd. (London).

Two 250-kVA transformers (including non-sludging oil).—Brush Electrical Engineering Co., Ltd. (Loughborough).

**Edinburgh.**—Although the Tramway Committee recommended acceptance of the tender of the Compagnie Anglo-Belge d'Importation et Export, Brussels, at £19,375 for rails and £775 for fishplates, the Town Council on Thursday last week agreed, by 33 votes to 23, to accept the tender of Dorman, Long & Co. at £25,150. Although there was a difference of £5,000 in the price, it was stated that the superior quality of the English rails compensated for the extra cost.

The Tramway Committee recommended acceptance of the tender of Cravens, Ltd., amounting to £12,989 for car-top covers, but on a division at the Town Council meeting the contract was given to McHardy & Elliot, Ltd., at £14,260.

**Glasgow.**—Sub-Committee on Prevention of Tuberculosis. Recommended:—

Electric cable required for water-pumping installation at Knightswood hospital (£131).—W. C. Martin & Co.

Tramways Committee. Recommended:—

Trolley wire.—Enfield Ediswan Cable Works, Ltd.

Housing Committee. Recommended:—

Second development of the electric lighting installation at Mosspark (£2,290).—Mr. R. J. McIntyre.

For the electric lighting installation at Sandyhills housing scheme (£1,170).—Mr. D. Henderson.

Electricity Committee. Recommended:—

Transformers for sub-stations.—Messrs. Ferranti, Ltd., for four 100-kVA transformers (£680); and the British Electric Transformer Co., Ltd., for two 200-kVA transformers (£530).

**Leeds.**

Electrical installation in the new premises of Messrs. Montague Burton, Ltd.—Cloke's Extension, Ltd.

**London.**—HACKNEY.—Finance Committee. Recommended:

48 tipping tubs for the electric vehicles used in the collection of house and trade refuse (£1,584).—Ransomes & Rapier, Ltd.

Battery-charging plant.—Two 50-amp. 5-wire balancers for the Karteret main switchboard (£675).—Lancashire Dynamo & Motor Co., Ltd.

**Maidstone.**—Town Council. Accepted:—

Boiler-feed pump for the electricity works (£157).—Messrs. Werners, Walton-on-the-Naze.

**Manchester.**—Baths and Wash-house Committee.

Electric lighting work at Newton Heath public wash-house.—J. Armstrong and Co.

Cleansing Committee.

Electric lighting installation at the Oldham Road works.—J. V. Pyatt.

Education Committee.

Electric lighting installation Mansfield Street and Seymour Road schools.—Sudlow & Co.

Electricity Committee.

Cable.—W. T. Glover & Co., Ltd.

Gas Committee.

Telephone installation extensions.—L. E. Wilson & Co.

Dry-cell batteries.—E. M. Evans & Son, Ltd.

**Middleton.**—Town Council. Accepted:—

Erection of new sub-station at the electricity works (£1,783).—R. Taylor, Middleton.

**New Zealand.**—WELLINGTON.—During the last few days the New Zealand Government has accepted tenders from British manufacturers for hydro-electrical materials to a total value of £81,993. Foreign firms competed in each instance.—*Reuter* (Wellington).

**Silvanus Thompson Memorial Lecture.**—Sir Oliver Lodge is to deliver the Silvanus Thompson Memorial Lecture at the Finsbury Technical College, E.C., on February 1st, and he will take as his subject "The Basis of Wireless Communication." Sir C. A. Parsons, K.C.B., will occupy the chair. A conversazione will be held subsequently, at which Dr. Thompson's apparatus and paintings will be exhibited. Tickets may be obtained from the hon. secretary at the college.

## FORTHCOMING EVENTS.

**Association of Mining Electrical Engineers.**—LOTHIANS BRANCH.—Saturday, January 13th. At the Heriot Watt College, Edinburgh. Questions and answers.

**Birmingham and District Electric Club.**—Saturday, January 13th. At the Grand Hotel, Colmore Row. At 7 p.m. Presidential address by Mr. C. G. McDonald.

**Institute of Transport (Graduates' and Students' Section).**—Tuesday, January 16th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 5.30 p.m. Lecture on "The Employment of Transport in Relation to Post Office Operations," by Mr. H. C. Gunton.

**Illuminating Engineering Society.**—Tuesday, January 16th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Discussion on "The Need for Suitable Training in Illuminating Engineering," to be opened by Mr. C. E. Greenslade and Mr. J. E. S. White.

**Institution of Engineers and Shipbuilders in Scotland.**—Tuesday, January 16th. At Rankine Hall, Glasgow. At 7.30 p.m. Ordinary meeting.

**Industrial League and Council.**—Wednesday, January 17th. At Caxton Hall, Westminster, S.W. At 7.30 p.m. "A Talk About Economics," by Sir Ernest J. Benn, Bart.

**Institution of Electrical Engineers.**—Thursday, January 18th. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "Works Production," by Mr. G. H. Nelson.

**(Liverpool Sub-Centre).**—Monday, January 15th. At the University, Liverpool. At 7 p.m. Paper on "The Possibilities of Transmission by Underground Cables at 100,000-150,000 V," by Major A. M. Taylor.

**(Students' Section).**—Saturday, January 13th. Visit to Messrs. Morgan Crucible Co.'s works at Battersea.

**(Sheffield Sub-Centre).**—Wednesday, January 17th. At the Royal Victoria Hotel, Sheffield. At 7.30 p.m. Paper on "Power Factor: Its Technical and Commercial Aspects," by Mr. H. E. Yerbury.

**Northampton Engineering College Engineering Society.**—Thursday, January 18th. At the College, St. John Street, E.C. At 5.30 p.m. Paper on "The Gyro-Compass," by Mr. J. W. Perkins.

**Chelmsford Engineering Society.**—Thursday, January 18th. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Stainless Steel," by Mr. H. Brearley.

**Institution of Mechanical Engineers.**—Friday, January 19th. At the Institution, Storey's Gate, S.W. At 6 p.m. Symposium of short papers: "Indicators."

**British Electrical Development Association.**—Friday, January 19th. At Caxton Hall, Westminster, S.W. At 7.30 p.m. Salesmanship Conference. Paper on "Wiring Salesmanship in Relation to Spring Cleaning, Decoration, &c.," by Mr. H. T. Young.

**Junior Institution of Engineers.**—Friday, January 19th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette. "Laminated Springs," by Mr. T. H. Sanders.

**Association of Engineers-in-Charge.**—Saturday, January 20th. At St. Bride's Institute, Ludgate Circus, E.C. At 7.30 p.m. Social and dance.

**Chemical Society.**—Thursday, January 18th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

## NOTES.

**The Electro-Harmonic Society.**—The fourth concert of the season was held on January 10th at Caxton Hall, Westminster, Mr. Archibald Page, M.I.E.E. (an Electricity Commissioner), presiding. The programme was a varied one, and encores were numerous. The vocalists were: Miss Marion Browne (soprano), Miss Lucie Flanders (contralto), and Mr. Edward Halland (bass); Miss Nora Drake also rendered songs at the piano. Flute solos of admirable quality and execution were given by Miss Edith Penville, and Messrs. Emil Clare and Walter Montagu provided the lighter part of the programme. An unexpected pleasure was the appearance of Miss Marie Dainton, from the Coliseum, who greatly amused the large audience with her clever character sketches. Mr. Bernard Flanders, A.R.A.M., officiated at the piano in his usual masterly manner.

**The British Electrical and Allied Industries Research Association.**—The above-named Association has issued its second annual report, the bulk of the information given under the various sectional headings of which has already been published from time to time in the Association's quarterly reviews of progress. The Government departments, engineering, and scientific institutions and associations, universities, colleges, public bodies, and the like co-operating in the work of the Electrical Research Association now number 40; the number of members of the Association during the year ended September 30th, 1922, was 134, and the number of standing committees and sub-committees 49. The report, which covers the period October 1st, 1921, to September 30th, 1922, points out that notwithstanding further development of the organisation during the year, it is evident, both from inquiries and proposals received by the Association, and from the growth of the work of the established sections, that there is still a large field in which research is urgently required, which could be profitably explored at once if the necessary funds were forthcoming. Unfortunately it has been necessary to reduce expenditure on the least urgent researches so that the most profitable work may not suffer unduly. A gratifying feature of the year's work is the increasing extent to which large manufacturers generally, and specialists in particular lines, have extended their co-operation with the Association. It has been proved that there are some things the Association can do for such members which they cannot do so well by themselves, and further, that the large manufacturers with large technical staffs are best able to appreciate and utilise the results obtained. At the same time, the smaller concerns have an equal share in the organisation, which to them in a measure takes the place of the research and technical departments owned by the larger manufacturers. A large number of researches have reached the report stage during the year. Especial attention should be drawn to the number of reports and technical publications issued dealing with insulating materials. These are in the nature of specifications giving new and important data on classification, and on methods of testing.

**The "Model Engineer" Exhibition.**—As was to be expected, radio-telephony apparatus is the predominant feature of the *Model Engineer* Exhibition at the Royal Horticultural Hall, which closes to-day. A number of firms exhibit such apparatus, including MESSRS. LESLIE MCMICHAEL, LTD., who have several types of valve receiving sets, including Army patterns adapted for broadcasting. Special features of the stand are loud speakers ("Brown" and "Amplion") of various sizes, and the "Ducon" adapter for connecting a receiving set to a lighting installation, which acts as an aerial. This consists of two condensers in an insulating case with pins to engage with the lamp socket terminals. There are two lower terminals, either or both of which can be connected to the receiving set, according to the type of current, voltage, &c., of the lighting supply.

Other firms showing radio sets, parts, and materials are MESSRS. G. Z. AUCKLAND & SON, J. P. BOWER & CO., LTD., the PETO-SCOTT CO., the WAINWRIGHT MANUFACTURING CO., LTD., the BOWYER-LOWE CO., and others. The GRAFTON ELECTRICAL CO. displays a wide variety of electrical material and appliances, including small motor-generator sets, telephone apparatus, radio sets, switches, and lampholders. The ECONOMIC ELECTRIC, LTD., also shows a large collection of small electrical equipment, such as toy motors and dynamos, telephones, model engines, &c.

MESSRS. F. YATES & SONS, LTD., exhibit accumulators, small dynamos, instruments, switches, &c.

MR. M. W. WOODS has on view examples of the battery-charging rectifier described in the "New Devices" columns of our issue of December 15th, as well as rotary transformers (d.c. to d.c.), and a commutator motor with simple and complete regulation.

Among the exhibits of the various model engineering societies are excellent replicas in miniature of boats, steam, oil, and gas engines, generators, &c. A battery-charging set is on view, consisting of a gas engine belt-driving a generator and a well-made switchboard. There is also a small-scale reproduction of an electric locomotive. The possibilities of electrical control are demonstrated with a toy locomotive, which is electrically driven up and down a line, operating reversing relays when it reaches certain points on the track.

The steam locomotives made and operated by members of the Society of Model and Experimental Engineers are of great interest, their appearance belying their power.

**New Device to Prevent Static Interference.**—Prevention of static interference in the reception of radio signals has been solved, it is stated, by an invention of Dr. B. Galen McCaa, of Ephrata, near Lancaster, Pa., U.S.A. Two different systems have been developed that function on an antenna at any wave length; either one, when combined with a tone selective device that has been developed, operates to eliminate statics. In California this summer a static of 6,000 audibility was reduced to five, at which time commercial signals were received at 250 times the strength of the static. The second system, developed in his laboratory since his return East, has produced results superior to those obtained in California, he declares, adding:

"Tests have been made on the latest development at 360 metres on which a broadcasting telephone system is operated, and it is known that the device will operate on all radio systems at any wave lengths. The latest device is free from critical adjustments and is absolutely stable in operation, requiring no attention.

"The fact that it operates on an antenna makes it applicable for use on ships at sea, and becomes another important factor in life-saving by assuring absolute communication between vessels under conditions at which they cannot now operate."—*T. & T. Age.*

**X-ray Treatment.**—"In my view, not only in the interest of public safety, but also in the interest of radiology, all X-ray treatment should be under Government licence."

Dr. A. E. Barclay, of the Manchester Royal Infirmary, made this observation, according to the *Daily Dispatch*, on January 2nd, in the course of an address to the members of the Röntgen Society in London on the organisation and equipment of a modern X-ray department. He laid it down as an axiom that no intensive X-ray installation should be considered in a hospital where the whole-time services of a medical officer of the X-ray department were not available.

"Until such time as we know the value and best use of maximum doses of radiations of extreme penetration this treatment," he said, "must be under the closest supervision of a medical officer, and it cannot be left to any assistant.

The provision of this type of apparatus in smaller hospitals, especially when there is not a thoroughly efficient medical officer in charge, is certain to lead to disastrous results, which will bring, and already have brought, discredit to a new and powerful ally in the very few valuable forces that we can call to our aid in the war against malignant disease."

**Educational.**—The University Engineering College, Westgate-on-Sea, has sent us a booklet containing testimonials from students and others who have benefited by the Institute's correspondence courses.

**Appointments Vacant.**—Engineer, for the Ware Park Sanatorium, near Hertford; assistant mains engineer ($400 a month, dollar=2s. 4d.), for the George Town, Penang, Municipal Council; student engineers, for the Newcastle-upon-Tyne Electric Supply Co., Ltd.; plumber-jointer, for the Wolverhampton Corporation Electricity Department; instrument mechanician (Rs. 500 per mensem+) for the Telegraph Workshops, Alipur, Iindia; plumber-jointers for the Newport (Mon.) electricity department; switchboard attendant (69s. 6d.), for the Redditch Urban District Council electricity department. (See our advertisement pages to-day.)

**Transatlantic Radio Experiments.**—A series of experiments in Transatlantic radio telegraphy has just been completed in South London by members of the Radio Society of Great Britain, the organisation formerly known as the Wireless Society of London. The object of the experiments was, says *The Times*, to show the practicability of communication between this country and America on a far shorter wavelength and much lower power, and with a much smaller, less complicated and expensive aerial, than are used by the official and commercial stations. The experiments were made on ten successive days, from December 22nd, with apparatus installed at the base of the chimney on the premises of the County of London Electric Supply Co., at Wandsworth. The aerial consisted of six wires on a hoop 5 ft. in diameter, fitted to the chimney, 170 ft. high. The maximum wavelength used throughout the ten days was two hundred metres, and the maximum power 1.5 kW. The call number of the station was 5 W.S. These successful experiments were a unique achievement for British amateurs. Official and commercial stations, when communicating with America and other distant countries, use wave-lengths of from 15,000 to 30,000 metres, and power from 250 to 350 kilowatts. The tests impressed the authorities, who had been inclined to doubt their usefulness ever since the society first contemplated making them, nearly a year ago.

**Anti-Dazzle Vehicle Lamps.**—The *Daily Mail* motoring correspondent explains that he recently tested two different types of headlights for which absence of dazzle was claimed. The lamps complied with the provisions of the Anti-Dazzle Light Bill.

One of the provisions of this Bill, which will be introduced in Parliament next session, is that where the range of lamps exceeds 150 ft. a beam must be used which falls below the vision of approaching pedestrians or drivers of other vehicles. The Gramac headlight can be controlled from the dashboard and can be used either as an anti-dazzle or as an ordinary headlight. The anti-dazzle effect can, however, be made permanent if necessary. The test was carried out on a road on Wimbledon Common where there are no street lamps. The anti-dazzling effect is created by cutting out the top half of the beam. The lamps give a low semi-circular beam of great intensity parallel with the road at a height of about 4 ft., and in their non-dazzle position provide an ample driving light of a permanent nature if required. "We approached the lights from a distance of 200 yards—first on foot and then in another car. At no point except when standing close up to and above the lamp was any dazzle noticed." An important point with regard to this device is that it can be adapted to existing headlights. The Moonbeam non-dazzle headlamps gave equally good results. These lamps are worked much on the principle of a magic lantern. The beam is focused through a lens along and parallel with the road about waist-high. The driving light of these lamps was excellent. A feature noticed with both lights was the splendid illumination of the sides of the road.

One result of a flat beam, required by the new Bill if it becomes an Act, will be a difficulty in seeing the road signs. Although showing up the sides of the road a low beam will not illuminate effectively signposts and warning signals. But perhaps in time these will be made luminous.

**Guided-Wave Communication at Niagara.** — About eighteen months ago the Hydro-Electric Power Commission of Ontario decided to develop a system of guided-wave telephony for use in case of trouble on the physical telephone circuits of the Niagara system. A considerable amount of research and development work has now been done on both the apparatus and aerials. The points between which communication is to be established are the h.p. transformer stations. At each two aerials are strung on the towers about 25 ft. below the power conductors and for a distance of 2,500 ft. from the station. For the earth connection, the steel framework of the building and also the water pipes are used. The transmitters each have a capacity of 5 watts, *i.e.*, one 5-watt oscillating tube and one 5-watt modulator tube are used.

For power supply, a small dynamotor is operated from the 12-volt battery supplying the filaments of both tubes to generate a voltage of 500 which is applied to the plates of both tubes. The aerial coils of the transmitter with a small fixed condenser in series are placed directly between the aerial and ground. Across these coils is bridged the primary circuit of the receiver, protected from low-frequency surges by two small fixed condensers.

The receivers are of the regenerative type, with one stage of amplification. Radiotron No. U.V. 201 valves are used for both detecting and amplifying. To supply the filaments, a 6-volt battery, separate from the one required for the transmitter, is used and the power for the plate circuits is obtained from small dry cells; for the detector 35 volts and for the amplifier 70 volts. The transmitters and receivers are of the same design as used for straight radio communication and are operated in precisely the same manner as if the aerials were not in the proximity of power lines. The power conductors, however, guide the radio waves, and although a certain amount of energy is re-radiated from them, the energy reaching the aerial at the receiving end is much greater than would be obtained without their guiding effect. The system is, therefore, more efficient and at the same time gives greater secrecy than a system using unguided radio waves.

While the range of these sets for straight radio communication would not likely be greater than from eight to ten miles, quite satisfactory communication is obtained between transformer stations fifty miles apart when the power conductors are used as a guide.—*Bulletin* of the Commission.

## INSTITUTION NOTES.

**Institution of Electrical Engineers.**—The Late Sir J. Gavey.—At the meeting of the Institution, on January 4th, the president (Mr. F. Gill) referred in a few well-chosen words to the death of Sir John Gavey, and proposed a resolution of condolence with his relatives, which was passed by the members standing in silence.

Informal Dinner.—It has been arranged for the members of the Institution to dine together informally at the Engineers' Club on January 18th. Prospective diners are requested to communicate with the secretary as early as possible.

Annual Dinner.—The annual dinner of the Institution will be held at the Hotel Cecil on Tuesday, February 6th.

Argentine Centre.—The fourth annual dinner of the Argentine local Centre of the Institution took place on December 1st, 1922, at Buenos Ayres. The chair was occupied by the President (Mr. J. Wilson, O.B.E., electrical engineer of the Buenos Ayres Western Railway), and amongst the members and guests present were: Mr. L. Cooper (president of the Association of British Engineers in the Argentine Republic), and Messrs. Ernest Cooper (Anglo-Argentine Tramways Co.), L. T. Peck (Westinghouse Electric International Co.), D. H. Nye (Anglo Argentine General Electric Co.), A. A. Kelly (local hon. secretary and treasurer of the Institution of Electrical Engineers), G. E. F. Webber (Messrs. Merz & McLellan), W. C. Laidler (Cia. de Electricidad de la Prov. de Buenos Ayres), F. W. Robertes (Union Telephone Co.), N. C. Rowan (Cia. de Electricidad del Rio de la Plata), F. Harris (Henley Cable Co.), Honor (Western Telegraph Co.), A. C. Towers (Westinghouse Electric International Co.), J. H. Taylor (hon. secretary Association of British Engineers), J. Hacking (Messrs. Merz and McLellan), H. Aldum (Cia. de Electricidad de la Prov. de Buenos Aires), and Ian G. Laidlaw (Met.-Vickers Co.).

The dinner and subsequent proceedings constituted an altogether enjoyable function. Interspersed between the brief speeches were a number of vocal and instrumental items. During the dinner radio-telephone apparatus, installed for the occasion by the Westinghouse Electric International Co., enabled the company to listen to a variety of musical selections.

Earlier in the evening the annual meeting of the Centre had been held, when the following gentlemen were elected members of committee for the following year: S. D. Barnwell, W. C. Laidler, G. E. F. Webber, J. Wilson, R. A. Harris, H. Aldum, H. B. Sale, V. Lindop, and A. C. Kelly.

It is pleasing to be able to record the flourishing state of this Centre of the Institution. It brings together for mutual pleasure and profit the majority of the members of a profession whose importance in this Republic is constantly increasing —with the country's development. During the course of each year the members find time to pay visits to important establishments (factories, electrical installations, &c.) in or near the capital.—*Review of the River Plate.*

**Institution of Mechanical Engineers.**—A committee consisting of representatives of the Institutions of Mechanical Engineers and Naval Architects has been appointed with the objects of carrying out tests on oil engines and of reporting on the performance of motor-driven vessels. The Engineer-in-Chief of the Fleet has, with the approval of the Admiralty, joined this committee. In scope the proposed trials will include economy and thermo-dynamic tests ashore and

manœuvring tests at sea. Wherever possible the behaviour of the propellers and the hull will be examined. It is intended to test engines of as many representative types as possible. It is anticipated that the first actual testing work will be carried out about April next.

**Birmingham and District Electric Club.**—The following are the arrangements for the second half of the session :—

January 13th.—Presidential address by Mr. C. G. McDonald.
February 10th.—"Advertising and Salesmanship in Relation to the Electrical Industry," by Mr. J. W. Beauchamp.
March 10th.—"Wave Transmission," by Mr. W. Dinwoodie.
April 14th.—"Engines for Small Electric Generating Plants," by Mr. E. Caldwell.

## OUR PERSONAL COLUMN.

*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*

Walton-le-Dale Urban District Council has appointed Mr. G. J. GIBBS as engineer to the Council in connection with the supply of electricity to the district.

Mr. THOS. ROLES, Bradford city electrical engineer, who has been on sick leave in the South since October, was expected back at duty early in January, but is found to be not yet well enough, and has been granted an extension.

We recently announced that Mr. S. J. Watson, of Bury, had been appointed to the Salford post. We now learn that Mr. J. G. POTTS, works superintendent at the Bury electricity works, succeeds Mr. Watson, at £750 a year, and the services of Mr. Watson have been retained in an advisory capacity for six months at £200.

Congratulations to SIR PHILIP and LADY DAWSON on the occasion of their silver wedding, which they are celebrating to-day, Friday.

Our U.S. contemporary, *Telegraph & Telephone Age*, announces the retirement of Mr. THOMAS M. BRENNAN—"probably the best-known figure in telegraph circles in the United States"—from further active service. He had been for over sixty years prominently identified with the main office of the Western Union Telegraph Co., New York City, in important capacities. He was born in Ireland in 1844, and is therefore 78 years of age. He rose from messenger to active association with everything pertaining to the management of the New York main office.

The same American contemporary says that on January 1st Major-General JAMES G. HARBORD (since June, 1921, Deputy Chief of Staff of the U.S. Army) became president of the Radio Corporation of America, succeeding Mr. E. J. Nally, who on that date took up his new duties as managing director of international relations of the Radio Corporation with headquarters in Paris.

Mr. E. P. PAGE has been appointed sales manager to the London Factors & Agents, Ltd.

Mr. W. JOHNSTONE, executive director of the Brush Electrical Engineering Co., Ltd., Loughborough, has been appointed by the board to succeed the late Mr. B. Broadhurst.

Mr. MAUGHAN, after being associated with the company for the past eleven and a half years, has been appointed general manager of the Australian General Electric Co., Ltd.

On January 3rd, Southampton Borough Council debated the question of the salary of its electrical engineer. Mr. TURNER had objected to being brought under a recent decision of the Council to deduct 10 per cent. from municipal wages and salaries. The engineer had pointed out that according to the resolution his salary would be reduced from £1,000 to £900, or £80 below the minimum for a station of such output under the agreement made with the Associated Municipal Electrical Engineers. The Electricity Committee recommended that the engineer's salary be on the scale of the agreement. Mr. F. R. Brown, chairman of the committee, said it was almost unheard of to reduce the salary of the man at the head of an undertaking when it was doing well. Mr. Turner was appointed, after the war, at £1,000 a year, and no conditions were attached at that time to the payment of that salary. The engineer had saved the Council thousands of pounds that might have been spent in consultants' fees. Alderman Kimber argued that to make an exception in the case of the electrical engineer would bring in applications from many other officials for exemption. The engineer would be as well off with £900 a year now as he was with £1,000 when appointed. If Mr. Turner was put on the scale mentioned, his salary would go up with every million units sold, and it would be to his interest to rope in places like Eastleigh and Romsey that wanted supplies. Mr. Cross urged that if the reduction were persisted in, the Council might have occasion to wish it had paid a good man well. Ald. Kimber: Electrical engineers were scarce just after the war, but now they are as thick as blackberries. Ald. Hollis said that in two years Mr. Turner had had control of extensions costing £150,000. By 34 votes to 24 it was decided not to enforce the 10 per cent. reduction in the electrical engineer's case, but to place him on the agreement scale.

SIR T. O. CALLENDER, of whom we have pleasure in publishing an excellent, because most characteristic, photograph herewith, is, we suppose, as well-informed as an industrial leader can be of the trade situation of the world as affecting British electrical manufacturing. The study of books by specialists regarding the conditions of life in different countries and the reading of reports, whether by one's own special representatives in their allotted areas or by His Majesty's Commissioners and other officers, provide a good education, for reading maketh a full man. Sir Tom, however, goes one better than this and has, in fact, done so for many years past, for he is a most frequent traveller abroad in the interests of his company—Callender's Cable and Construction Co., Ltd. When he is not abroad, he is at the head of the company's business in Hamilton House, on the Victoria Embankment in London, is in closest touch with the factory, and resides

SIR T. O. CALLENDER,
Managing Director of Callender's Cable & Construction Co., Ltd.

at Bidborough Court, near Tunbridge Wells. On the death in 1908 of his father, Mr. W. O. Callender, the founder of the firm, Mr. (now Sir) T. O. Callender became managing director, and under his direction the great developments in the company's business at home and abroad during the last fifteen years have taken place. For some years previous to his death, however, Mr. W. O. Callender had retired from the active management.

Sir Tom was born in Glasgow in 1855. He was knighted in 1918. For many years he resided at Abbey Wood, in the immediate vicinity of the factory, and during the trying years of the war he and Lady Callender were assiduous in their endeavours to help materially and socially, the very large numbers of soldiers and employés who were drafted into that district. We refer to the company's activities on another page.

MR. G. F. PRESTON, M.I.E.E., is retiring from the post of Controller of the London Telephone Service at the end of January, at the age of 62. Mr. Preston's electrical career (to which we hope to refer more fully later) dates back to the early 'eighties, when he entered the service of the Anglo-American Brush Corporation. For more than thirty years he has been closely associated with the telephone service.

MR. C. H. WORDINGHAM, C.B.E., M.Inst.C.E., has removed from No. 11, Mosley Street, to more centrally-situated offices at 33, Brazennose Street, Manchester. His telephone number, *viz.*: Central 823, remains as before. MR. R. W. WILLIS, M.I.E.E., is assistant in charge of his Manchester office.

The November issue of the *Commonwealth Engineer* (Melbourne) just to hand, contains the following: "MR. FREDERICK GOLDING, chief electrical engineer of the Commonwealth Postmaster-General's Department, appeared before a departmental board last month to answer charges laid against him by Mr. Oxenham, the secretary of the department. The charges were that on December 2nd, 1921, while on an official visit to England and the Continent, he harboured and imported into England from Calais two pairs of binoculars, one pair of opera glasses and a wristlet watch; that he failed to comply with instructions from the secretary to the Postmaster-General; made misleading reports; made, without authority, an arrangement with Automatic Telephones, Ltd., for the substitution of rotary line switches for Keith switches; and made statements of a character and tone calculated to impair the efficiency and the harmonious conditions of the department, and to cause delay in the transaction of such business. The board has not yet arrived at any decision."

A later report appearing in the Sydney *Sun* (November 8th) states that as the result of the unanimous finding of the Board of Inquiry, Mr. Golding has been reduced to the status of engineer, this involving a reduction in salary from £1,000 to £600 a year.

A Brisbane newspaper report says that MR. G. R. STEER, secretary to the Railway Department, has been selected as chairman of the Brisbane Tramways Trust, which will control the system now under municipal ownership. He will retain his railway position.

MR. H. H. CURTIS has severed his connection with the British Thomson-Houston Co., Ltd., and joined the London office staff of Electromotors, Ltd., of Openshaw, Manchester.

The newspaper Press quotes a Russian report to the effect that PROFESSOR EINSTEIN and PROFESSOR SIR ERNEST RUTHERFORD (of Cambridge University) are among the foreign members and correspondents elected to the Russian Academy of Science.

After a long discussion the Oldham Town Council has decided to increase the salary of MR. F. L. OGDEN (borough electrical engineer) from £769 5s. (including £129 5s. bonus) to £900 per year inclusive. Mr. Ogden was an applicant for the recent vacancy at Salford, but withdrew after an interview with the Oldham Electricity Committee.

The F.B.I. *Bulletin* states that Sir ERIC GEDDES has accepted an invitation from Sir Philip Lloyd-Greame to become a member of the Advisory Council of the Board of Trade during his term of office as president of the F.B.I. and the succeeding year.

The Keighley Gas and Oil Engine Co., Ltd., has appointed Mr. W. A. SYCAMORE to be its London manager in succession to Mr. H. S. Aspinall, who has resigned his position. Mr. Sycamore was formerly with the British Westinghouse Co. at Trafford Park, and later at the company's London office until the outbreak of the war, when, having a commission in the London Electrical Engineers, R.E. (T.), he was on war service. After the Armistice he joined the Keighley Co. as a members of its selling staff.

The British Thomson-Houston Co., Ltd., announce the appointment as managing director of Mr. W. C. LUSK, who has been director in charge of the sales department of the company for a number of years. Mr. H. C. Levis, who held the position of chairman and managing director, continues as chairman of the company.

**Obituary.**—SIR JOHN GAVEY.—At the funeral of Sir John Gavey, C.B., which took place at Hampton Wick on Friday last, January 5th, the Council of the Institution of Electrical Engineers, of which Sir John, as mentioned in our last issue, was a past president, was represented by the following: Mr. F. Gill, president; Sir John Snell, Messrs. W. M. Mordey, and C. P. Sparks, C.B.E., past presidents; Dr. Alexander Russell and Mr. F. Tremain, members of Council; and Mr. P. F. Rowell, the secretary. The Post Office was represented by Major Purves, Engineer-in-Chief, and Mr. G. F. Preston, Controller of Telephones, and the United River Plate Telephone Co. by two of the directors and Mr. A. J. Davis, the secretary. Amongst those present, in addition to the members of the family, we observed Mr. Albert Anns, Mr. W. W. Cook, Mr. J. E. Kingsbury, Mr. A. Moir, and Mr. Dane Sinclair.

MR. W. R. NEWTON.—The death took place suddenly on January 4th of Mr. William Robert Newton, electrical engineer, of 4, Charnwood Street, and of the City Road Mills, Derby. He was 47 years of age.

MR. WM. BATES.—We regret to record the death of Mr. William Bates, M.Inst.C.E, formerly electrical engineer of Birkenhead. When he retired from the Corporation service, Mr. Bates entered the coal trade, and according to a Liverpool paper he was awarded the O.B.E. for his services during the war in connection with the coaling of ships on Government duty.

**Will.**—The late DR. GISBERT KAPP left £11,210.

## NEW COMPANIES REGISTERED.

**Electrical Power Equipment Co., Ltd.** (186,732).—Private company. Registered December 29th. Capital, £500 in £1 shares. To carry on the business of designers, manufacturers, and maintainers of plant, machinery, apparatus, and appliances for the generation, accumulation, transmission, and supply of electrical power, heat, and light, &c. The first directors are:—L. Porritt, Spring Field, Birstall, near Leeds (permanent chairman and governing director) (director Wm. Porritt & Son, Ltd.); J. Culkin, 32, St. James' Street, Leeds (managing director). Qualification of permanent chairman and governing director, £200; of ordinary director, £100. Registered office: Martin Street Works, Martin Street, Birstall, near Leeds.

**Wireless Agencies, Ltd.** (186,713).—Private company. Registered December 28th. Capital, £1,000 in £1 shares. To carry on the business of electricians, manufacturers of generators, accumulators, suppliers and distributors of electricity and electrical energy for lighting, heating, telegraphic and telephonic communications, &c. The permanent directors are:—D. Sharp (chairman), no address given; S. Forbes, 134, Oakwood Court, Kensington, W.8, engineer; E. Sharp, 16, Addison Court Gardens, West Kensington, W., merchant; H. P. Sharp, 7, Avonmore Road, Kensington, W.14, electrical engineer. The last three are joint managing directors. Solicitors: Kenneth, Brown, Baker & Baker, Lennox House, Norfolk Street, W.C.2.

**Corporation for the Economic Development of Turkey** (186,759).—Registered on December 30th with a nominal capital of £250,000 in £1 shares. The objects are to search for, prospect, and deal in mineral and mineral substances of all kinds, oil and products thereof, and to carry on the business of mine and quarry owners, colliery proprietors, miners, smelters, cement manufacturers, oil refiners, manufacturers of chemical products, lime burners, brick makers, engineers, tin-plate workers, founders, ironmasters, steel makers, constructors of railways, tramways, telegraph lines, telephones, steamers, ships, barges, wagons, derricks, canals, docks, &c. The subscribers (each with one share) are:—Leslie Urquhart, Pinners' Hall, Austin Friars, E.C., gent.; Rustem F. Nedjib, Hotel Cecil, W.C., gent.; Robert G. Brown, Pinners' Hall, Austin Friars, E.C., gent.; Deane P. Mitchell, Pinners' Hall, Austin Friars, E.C., gent.; John P. B. Webster, Pinners' Hall, Austin Friars, E.C., gent.; H. J. Fisher, 9, Great St. Helens, E.C., solicitor; Herbert Gibson, 9, Great St. Helens, E.C., solicitor. Minimum cash subscription: 7 shares. The first directors (to number not less than three or more than 12) are: Rustem F. Nedjib Bey, Hussein Fuad Bey, Constantinople, Nedjib Zihni Bey, Smyrna, and Nedjib Niazi Bey, Constantinople. Qualification (except first directors): £500. Remuneration: 5 per cent. of the net profits, divided between them. Each director who is a Turkish subject shall be entitled to an additional fixed remuneration of £250 per annum. The registered office is at Pinners' Hall, Austin Friars, E.C.

**Bamford Works, Ltd.** (186,774).—Private company. Registered January 1st. Capital, £5,000 in £1 shares. To carry on the business of electrical, mechanical, civil, and constructional engineers, contractors and agents for the manufacture, supply, and installation of electrical, mechanical, constructional, heating, and hydraulic plant and machinery for steel works, ironfoundries, collieries, mines, railways, dockyards, shipbuildings, &c. The first directors are:—G. H. Smith (chairman), 27, Cobham Road, Kingston-on-Thames; W. H. Smith, 27, Cobham Road, Kingston-on-Thames; J. Davies, "Glenwood," Glencairn Park Road, Cheltenham (all permanent, subject to holding 500 shares each). Secretary: H. Rhodes. Registered office: "Tickleholme," Bamford, Derbyshire.

**Stensigns, Ltd.** (186,806).—Private company. Registered January 1st. Capital, £5,000 in £1 shares. To adopt an agreement with C. Kratt, Sir Henry Forde, and J. F. Barr and to carry on the business of manufacturers of and dealers in electrical signs, electric, mechanical, and general engineers, &c. The subscribers (each with one share) are:—E. A. Hopkins, 7, Southampton Street, Bloomsbury Square, W.C., clerk; E. O. M. Hall, 7, Southampton Street, Bloomsbury Square, W.C. The first directors are to be appointed by the subscribers. Secretary: H. Crafter. Solicitors: H. Crafter & Co., 7, Southampton Street, Bloomsbury Square, W.C.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**H. Maguire, Ltd.**—Trust deed dated December 16th, 1922, to secure £350, debenture stock, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: J. Lewenstein, 6, Wright Street, Hull.

**Lloyd & Ramsden, Ltd.**—Issue on December 9th, 1922, of £250 debentures, part of a series already registered.

**Amesbury Electric Light and General Supply Co., Ltd.**—Particulars filed of £2,500 debentures authorised December 27th, 1922, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

**London United Tramways, Ltd.**—Satisfaction in full on November 7th, 1922, of mortgage by way of assignment, dated August 8th, 1919, securing £200,000.

**C. J. Thursfield & Co., Ltd.**—Second mortgage debenture dated December 27th, 1922, to secure £1,500, charged on the company's undertaking and property, present and future, including uncalled capital and unpaid calls. Holder: R. C. S. Jamie, 106, Trafalgar Road, Moseley, Birmingham.

**Ozonair, Ltd.**—Issue on December 1st, 1922, of £3,300 debentures, part of a series already registered.

**Mitchell's Electrical and Wireless, Ltd.**—Particulars filed of £2,600 debentures authorised November 15th, 1922, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

**Edgar Phillips, Ltd.**—Mortgage on freehold premises, No. 61, Church Street, West Hartlepool, dated December 9th, 1922, to secure all moneys due or to become due from Lloyds Bank, Ltd., not exceeding £3,000.

**Imperial United Lamp Co., Ltd.**—F. W. Kellaway, of Thanet House, 231 and 232, Strand, W.C., was appointed receiver and manager on December 15th, 1922, under powers contained in mortgage dated January 24th, 1918.

**Mawdsleys, Ltd.** (91,783).—Return dated December 25th, 1922. Capital, £20,000 in £1 shares. 18,937 shares taken up; £6,937 paid; £12,000 considered as paid. Mortgages and charges, £6,300.

## CITY NOTES.

**Southern Canada Power Co.**

According to the *Financier*, the report for the year to September 30th last states that during the year the system was extended to serve East Farnham; a high-pressure transmission line was constructed between Actonvale and Granby, which will be of important assistance in improving the service in Granby district; sub-station capacities were increased and existing distribution plants were extended to take care of 13,249 customers, which the company was serving at the close of the year. The district served by the company has largely recovered from the effects of industrial depression noted at the close of the previous year. The output shows an increase of 17 per cent. for the year, and while merchandise sales were somewhat reduced, it would appear that the low point had been passed and that this branch of the company's activities would shortly show substantial recovery. Franco-Canadian Dyers, Ltd., have established plant at St. Johns, Premier Silk Mills, Ltd., at Cowansville, and Canadian United States Knitting Co., Ltd., at St. Hyacinthe. These are branches of important American industries, and negotiations now in progress indicate successful continuation of the efforts of the company in assisting to promote the industrial growth of the district. The gross earnings were $843,565; expenses, $385,663; interest, $66,847. Dividends on the preferred stock absorbed $19,911 and depreciation reserve $410,000, leaving a balance of $58,512.

**Provincial Tramways Co.**

For the year ended September 1922, the net revenue was £20,582, plus brought forward £2,675. No revenue was received from Plymouth after June 30th, and the wet summer and unemployment accounted for the reduced earnings. The lease of the Plymouth tramways expired on June 30th, 1922, when the lines reverted to the Corporation. Cardiff Corporation exercised its powers to run 'buses and took over the company's garage. The balance of expenditure on these two undertakings has therefore been written off. Arbitration for the suggested purchase of lines in the borough of Grimsby has not yet taken place. The directors recommend payment of preference dividend up to September 30th, 1922, for which provision has been made in the accounts, but with the sale of the Grimsby line in abeyance and cessation of revenue from Plymouth and Cardiff and state of trade, future payments (according to the financial Press) are uncertain.

**Stock Exchange Notices.**—Dealings in the following have been specially allowed by the Committee under Rule 159:—

Manila Electric Corporation.—Temporary certificates for $2,000,000 common stock.

The undermentioned have been ordered to be officially quoted:—

Calcutta Tramways Co.—£250,000 7 per cent. second debentures, Nos. 1 to 2,500 (£100) (registered).

Llanelly and District Electric Lighting and Traction.—135,000 ordinary shares of £1 each, fully paid, Nos. 1 to 60,000, 135,001 to 150,000, and 225,001 to 285,000; and £125,000 7½ per cent. debenture stock.

**North Metropolitan Electrical Power Distribution Co., Ltd.**—In accordance with the provisions of the North Metropolitan Electric Power Supply Act, 1922, and with the consent of the Electricity Commissioners, the undertaking of the above company became vested, as from December 30th, 1922, in the North Metropolitan Electric Power Supply Co. Under the 1922 Act the Power Supply Co. took over the undertakings of the Distribution Co., subject to all the existing rights, obligations, and liabilities of the Distribution Co. towards the local authorities, consumers, and others.

**North Metropolitan Electric Power Supply Co.**—The *Financial Times* stated last week that this company had submitted to the holders of its 7½ per cent. debenture stock notice of its intention to pay off at 100 the stock outstanding on July 1st next.

**National Boiler and General Insurance Co., Ltd.**—The Manchester correspondent of the *Financial Times* reported early this week that the above company had received an offer from the Alliance Assurance Co. to purchase its shares for a cash payment of £50 per share, plus a final dividend for 1922 of 20s. per share, less tax. The directors recommend the shareholders to accept the offer. The shares, it appears, are £10 each, of which £3 10s. is paid up, and the dividend for 1921 was 32s. per share.

**Anglo-American Telegraph Co., Ltd.**—The directors announce a balance dividend of £1 10s. per cent. upon the ordinary consolidated stock, making £3 15s. per cent.; balance dividend of £1 10s. per cent. upon the preferred stock; and a dividend of £1 10s. per cent. upon the deferred stock for the year, all less tax.

**Siemens Brothers & Co., Ltd.**—The directors have decided to defer their decision to pay the dividend for the half-year to December 31st last on the preference shares until the completion and audit of the accounts for the year and the settlement of liability for E.P.D. In our issue of November 24th it was announced that the directors were unable to make any interim distribution on the ordinary shares.

**Anglo-Argentine Tramways Co., Ltd.**—At an extraordinary general meeting held on January 4th the resolutions dealing with the arrears of dividend on the second preference shares were confirmed.

**Drake & Gorham, Ltd.**—The *Financial Times* states that about half of the issue of £50,000 10 per cent. seven-year notes have been drawn for repayment on May 7th.

**Mackay Companies.**—According to the *Financial Times*, a dividend of 1¾ per cent., and an extra dividend of 10 per cent. on the common stock, are announced.

## STOCKS AND SHARES.

TUESDAY EVENING.

NEITHER demoralisation in the franc and mark, nor crisis in the foreign political world had any particular effect upon the Stock Exchange markets other than those intimately concerned with the troubles mentioned. The railway market is good, and the change-over occasioned by the grouping arrangements has brought in a fresh accession of buyers of the stocks of the steam companies. There is a widespread impression that, with electrification carried out upon reasonable financial terms, the companies ought to do well in the future. The dividends in respect of the year just ended are not anticipated to be on any liberal scale, but is generally held that the 1923 distributions are likely to turn out very satisfactory to proprietors. Hence a rise in most of the new stocks. The Undergrounds, however, are somewhat on the dull side. Districts touched 47¼ but went back to 46, while Metropolitans fell back to 60; the issues of the Underground Electric Railways are unchanged on the week. East London debenture stocks came into prominence on Monday, the "B" putting on 2¼ points at 80¼, while the third and fourth debentures rose 3 and 1 to 40 and 17¼ respectively. East London ordinary stock is quoted at 4¾ middle. City & South London 4 per cent. debenture has risen to 77½.

Considering the long and steady rise which prices of the electricity supply shares have enjoyed during the past three months, and which was brought out in the striking table of comparisons given here last week, it is not particularly surprising to find a certain degree of caution manifested by the investor at the present moment. Indeed, he has withdrawn his support to some extent, with the consequence that the prices are disposed to ease off a little. The new County of London ordinary, for instance, after touching 6s. 6d. premium, went back to 5s. 9d. premium, though the quotation was soon rectified in favour of holders, and is up again to 6s. 3d. premium. County ordinary shares are 9d. lower on the week, and Metropolitans eased off. The list, however, retains its generally strong appearance. The first dividends are not expected to be announced until the end of next month. Newcastle-on-Tyne 5 per cent. preference at 15s. 9d. are 1/16 higher.

Marconi debentures are a rising market, and the price has improved to 4½ premium. The shares of the parent company, after touching 46s. 9d., went back to 45s., and Canadian Marconis, which were put up to 11s. 6d. on American support, sagged back to 10s. 9d. Marconis lack particular public interest, and, in spite of the advertisement given to broadcasting at the Christmas season, there is not sufficient active support afforded to the market to enable its prices to go ahead.

Anglo-American Telegraph preferred is ¼ better. West India and Panama shares have gone back to 7s. 6d. Great Northern Telegraphs at 28¾ are 5s. down. The Eastern group shows no change at all. United River Plate Telephones came on offer and dropped to 7, a fall of 10s. Jutland Telephone 5¼ per cents. at 102 are a point to the good.

Amongst manufacturing shares, British Insulated advanced sharply to 2 7/16, and Callenders are better at 2¼. Henleys at 2¾ are 5s. 7½d. better. British Aluminium ordinary at 16s. 3d. are the pence to the good. English Electric at 17s. 3d. are eighteenpence up. Many inquiries are reaching the market as to whether Edison-Swans at half-a-crown are worth picking up as a speculation.

Siemens rose from 22s. to 23s. 6d., but the price gave way sharply to a guinea on the posting of a notice in the Stock Exchange to the effect that the question of paying the dividend, due next week, on the preference shares is to be postponed until the accounts are made up in June, when the matter of E.P.D. will also be settled. This came as an unexpected blow to the market. It may be recalled that the company recently passed the dividend on its ordinary shares, but there was a prompt recovery from the fall which occurred on that occasion, the view being taken that Siemens have so good a business that a return to the dividend-stage would not be long delayed. This latest announcement in regard to the preference dividend is, however, calculated to arouse a little uneasiness, though it must be pointed out that there were a good many buyers ready to take whatever shares came in if the price should give way to anything like 20s.

The North Metropolitan Electric Power Distribution Co. has issued a notice to the effect that it has now become vested in the North Metropolitan Electric Power Supply Co.

Edmundsons ordinary have risen 6s. 3d. to 2¼, and Urban preference at 4 are 5s. up. There is a good deal of business doing in this market, and the substantial character of the rises in Callender's, Henleys, and British Insulated shows the eagerness of the purchasers.

When Stock Exchange permission is granted to deal in the new £1 shares of the Brompton & Kensington Electricity Supply Co., it is expected that the price of the shares will start on the basis of 26s. to 28s. A certain amount of confusion arose when the allotment letters first appeared, early this week, owing to the fact that these allotments included on the forms both the full shares and also the halves, in those cases where the latter had to be distributed. People who wanted to sell their half share complained that it would not be possible to do so without parting with the lot. To-night, however, (Tuesday) it is said that some method will be found by the company for meeting this obvious difficulty, and that no impediment will be placed upon freedom of dealing as soon as the market starts.

The foreign group, traction and lighting, is steady, with scarcely a change in Argentine, Brazilian, or Mexican issues. The iron and steel market keeps hard. Report from local centres in the provinces indicate that there is more trade afoot, and that the Government's efforts in the direction of alleviating unemployment are already having their effect upon industrial activity. The price of raw rubber rose to 1s. 3d. per lb., but went back a little. The rubber share market, however, remained very firm, and the principal feature is the absence of any noticeable supply of shares, in the good-class companies, to meet the demands of would-be buyers.

## SHARE LIST OF ELECTRICAL COMPANIES.

### HOME ELECTRICITY COMPANIES.

| | Dividend. 1920. | Dividend. 1921. | Price Jan. 9, 1923. | Rise or fall. | Yield p.c. |
|---|---|---|---|---|---|
| Brompton Ordinary ... ... ... | 12 | 12 | 7¼ | — | £5 14 3 |
| Charing Cross Ordinary ... ... ... | 8 | 9 | 7¾ | — | 5 16 2 |
| do. do. do. 4½ Pref.... ... | 4½ | 4½ | 4⅞ | — | 5 7 5 |
| Chelsea ... ... ... ... ... | 6 | 6 | 6¾ | — | 4 9 0 |
| City of London ... ... ... ... | 14 | 14 | 2⅞ | — | 6 7 10 |
| do. do. 6 per cent. Pref. ... | 6 | 6 | 23/- | — | 5 4 4 |
| County of London ... ... ... ... | 8 | 8 | 1⅛ | —9d. | 5 2 5 |
| do. do. 6 per cent. Pref. ... | 6 | 6 | 1⅛ | — | 5 4 4 |
| Edmundson's Ordinary ... ... ... | Nil | Nil | 2½ | + ⅛ | Nil |
| do 6 per cent. Pref. ... | 6/- | 12/- | 4⅜ | — | 6 17 2 |
| Kensington Ordinary ... ... ... | 9 | 10 | 8 | — | 6 5 0 |
| London Electric ... ... ... ... | 2½ | 4 | 8 | — | 4 0 0 |
| do. do. 6 per cent. Pref. ... | 6 | 6 | 5⅛ | — | 5 17 1 |
| Metropolitan ... ... ... ... ... | 7 | 7 | 6⅜ | — ¼ | 5 9 7 |
| do. 4½ per cent. Pref. ... | 4½ | 4½ | 4 | — ¼ | 5 12 6 |
| Newcastle-on-Tyne Ordinary ... ... | 8 | Nil | ⅛ | — | Nil |
| do 5 per cent. Pref. ... | 5 | 5 | 15/9 | + 1/16 | 6 7 0 |
| do 7 per cent. Pref. ... | — | 7 | 22/- | — | 6 7 3 |
| Notting Hill, 6 per cent. Pref. ... ... | 6 | 6 | 9 | — | 6 13 4 |
| North Met. Elec., 6 per cent. Pref. ... | 6 | 6 | 1⅛ | — | 5 13 0 |
| Urban Ordinary ... ... ... ... | Nil | Nil | 1⅛ | — | Nil |
| do 5 per cent. Pref. ... | 2½ | 2½ | 4 | + ¼ | 6 5 0 |
| St. James' and Pall Mall ... ... ... | 12 | 12 | 9½ | — | 6 6 4 |
| South London ... ... ... ... | 7 | 7 | 4⅜ | — | 5 18 0 |
| South Metropolitan Pref. ... ... ... | 7 | 7 | 1⅞ | — | 5 18 0 |
| Westminster Ordinary ... ... ... | 10 | 10 | 7¼ | — | 6 7 0 |
| Whitehall Elec. Inst., 7½ per cent. Pf. | — | 7½ | 17/6 | — | 8 11 6 |

### TELEGRAPHS AND TELEPHONES.

| | | | | | |
|---|---|---|---|---|---|
| Anglo-Am. Tel. Pref. ... ... ... | 6 | 6 | 103½ | + ½ | 5 16 0 |
| do. Def. ... ... ... | 1½ | 34/6 | 24¼ | — | 6 4 4 |
| Chile Telephone ... ... ... ... | 6 | 6 | 6¼ | — | 4 16 0 |
| Cuba Sub. Ord. ... ... ... ... | 7 | 7 | 7⅜ | — | 9 0 8 |
| Eastern Extension ... ... ... ... | 10 | 10 | 19½ | — | 5 4 0 |
| Eastern Tel. Ord. ... ... ... ... | 10 | 10 | 190½ | — | 5 5 0 |
| Globe Tel. and T. Ord. ... ... ... | 10 | 10 | 19¼ | — | 5 5 0 |
| do. do. Pref. ... ... ... | 6 | 6 | 11½ | — | 5 6 8 |
| Great Northern Tel. ... ... ... | 24 | 22 | 28⅜ | — ½ | 7 15 0 |
| Indo-European ... ... ... ... | 10 | 10 | 35½ | — | 7 1 0 |
| Marconi... ... ... ... ... ... | 25 | 15 | 2¼ | — 1/16 | 6 13 4 |
| Oriental Telephone Ord. ... ... ... | 12 | 12 | 2⅞ | — | *5 4 0 |
| United R. Plate Tel. ... ... ... | 8 | 8 | 7 | — ¼ | *5 14 4 |
| West India and Panama ... ... ... | Nil | Nil | 7/6 | — ⅛ | Nil |
| Western Telegraph ... ... ... ... | 10 | 10 | 18⅞ | — | *5 6 8 |

### HOME RAILS.

| | | | | | |
|---|---|---|---|---|---|
| Central London Ord. Assented ... ... | 4 | 4 | 67 | — | 5 19 5 |
| Metropolitan ... ... ... ... ... | 1½ | 2½ | 60 | —1 | 8 15 0 |
| do. District ... ... ... | Nil | 1 | 46 | —1 | 2 3 6 |
| Underground Electric Ordinary... ... | Nil | Nil | 2⅛ | — | Nil |
| do. do. "A" ... ... | Nil | Nil | 7/- | — | Nil |
| do. do. Income ... ... | 2 | 4 | 87½ | — | *4 11 5 |

### HOME AND FOREIGN TRAMS, &c.

| | | | | | |
|---|---|---|---|---|---|
| Anglo-Arg. Trams. First Pref. ... ... | 5½ | 12½ | 3⅝ | — | 7 11 9 |
| do. do. 2nd Pref. ... ... | Nil | 5½ | 4½ | — | 6 2 3 |
| do. do. 5 per cent. Deb. ... | 5 | 5 | 80½ | — | 6 2 8 |
| British Electric Traction Ordinary ... | 4½ | — | 64 | — | 7 0 8 |
| do 6 per cent. Pref. ... | 6 | 6 | 94 | — | 6 7 8 |
| Brazil Tractions ... ... ... ... | Nil | Nil | 47½ | — | 8 8 6 |
| British Columbia Elec. Rly. Pcs. ... | 5 | 5 | 78½ | — | 6 7 5 |
| do. do. Preferred ... | 5 | 93/- | 76½ | — | *6 3 6 |
| do. do. Deferred ... | 5 | 124/- | 87½ | — | *7 0 6 |
| do. do. Deb. ... ... | 4¼ | 4¼ | 78½ | — | 5 8 3 |
| Lond. and Sub. Trac., 5 per cent. Pf.... | 2½ | 3½ | 10/- | — | 7 0 0 |
| London United Tram deb. ... ... | 4 | 4 | 61½ | —2½ | 6 10 1 |
| Mexico Tram. 5 per cent. Bonds ... | Nil | Nil | 81½ | — | 6 2 8 |
| do. 6 per cent. Bonds ... | Nil | Nil | 69½ | — | Nil |
| Mexican Light Common... ... ... | Nil | Nil | 21½ | — | Nil |
| do. Pref. ... ... ... | Nil | Nil | 51½ | — | Nil |
| do. 1st Bonds. ... ... | Nil | 5 | 67 | — | 7 8 2 |

### MANUFACTURING COMPANIES.

| | | | | | |
|---|---|---|---|---|---|
| Babcock & Wilcox ... ... ... ... | 15 | 15 | 8½ | — | 4 11 6 |
| British Aluminium Ord. ... ... ... | 10 | 5 | 16/3 | +3d. | 6 3 1 |
| British Insulated Ord. ... ... ... | 15 | 15 | 9⅞ | + ⅛ | 6 3 0 |
| Callenders ... ... ... ... ... | 15 | 15 | 2¼ | + 1/16 | 6 13 4 |
| do. 6½ Pref.... ... ... ... | 6½ | 6½ | 1⅛ | — | 5 15 7 |
| Crompton Ord. ... ... ... ... | 10 | 5 | 15/- | — | 6 13 4 |
| Edison-Swan ... ... ... ... ... | 10 | Nil | 2/6 | — | Nil. |
| do. do. 5 per cent. Deb. ... ... | 5 | 5 | 63 | — | 7 18 9 |
| Electric Construction ... ... ... | 10 | 10 | 1⅜ | — | 7 5 6 |
| English Electric ... ... ... .. | 8 | 5 | 17/3 | +1/6 | 6 16 0 |
| do. do. Pref. ... ... ... | 6 | 6 | 18/3 | — | 6 10 6 |
| Gen. Elec. Pref. ... ... ... ... | 6½ | 6½ | 21/9 | — | 5 19 6 |
| do. Ord. ... ... ... ... | 10 | 5 | 1 | +1/6 | 5 0 0 |
| Henley ... ... ... ... .. | 15 | 15 | 2⅛ | + ⅛ | 6 6 4 |
| do. 4½ Pref. ... ... ... ... | 4½ | 4½ | 4⅜ | — | 5 2 10 |
| India-Rubber ... ... ... ... ... | 10 | — | 11/3 | — | — |
| Met.-Vickers Pref. ... ... ... ... | 8 | 8 | 2⅞ | — | 6 11 2 |
| Siemens Ord. ... ... ... ... ... | 10 | 10 | 21/- | —10½d. | Nil. |
| Telegraph Con. ... ... ... ... | 20 | 20 | 25½ | — | *4 11 6 |

* Dividends paid free of Income Tax.

## MARKET QUOTATIONS FOR CHEMICALS AND METALS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

| CHEMICALS, &c. | Price January 10th. | Fortnight's Inc. or dec. |
|---|---|---|
| *a* Acid, Oxalic ... ... ... ... per lb. | 6½d. | ... |
| *a* Ammoniac, Sal ... ... ... per ton | £63 | £1 inc. |
| *a* Ammonia, Muriate (large crystal) ,, | £48 | ... |
| *a* Bisulphide of Carbon ... ... ,, | ... | ... |
| *a* Borax... ... ... ... ... ,, | £28 | £2 dec. |
| *a* Copper Sulphate ... ... ... ,, | £26 15s. | ... |
| *a* Potash, Chlorate ... ... ... per lb. | 4d. to 4½d. | 1d. dec. |
| *a* ,, Perchlorate ... ... ,, | 6½d. | 1½d. dec. |
| *a* Shellac ... ... ... ... per cwt. | £19 | 25s. inc. |
| *a* Sulphur, Sublimed Flowers ... ,, | £9 | ... |
| *a* ,, Lump ... ... ... ,, | £9 2s. 6d. | ... |
| *a* Soda, Chlorate ... ... ... per lb. | 3½d. | ... |
| *a* ,, Crystals ... ... ... per ton | £6 | ... |
| *a* Sodium Bichromate, casks ... per lb. | 5d. | ... |
| **METALS, &c.** | | |
| *b* Aluminium, Ingots... ... ... per ton | £100 | ... |
| *b* ,, Wire ... ... ... per lb. | 1/9 to 2/6 | ... |
| *b* ,, Sheet ... ... ... ,, | 1/6 to 2/- | ... |
| *p* Babbitt's Metal and Anti-friction Metal— | | |
| Grade I ... ... ... per ton net | £164 | £2 dec. |
| Grade II ... ... ... ,, ,, | £121 | £1 dec. |
| Grade III ... ... ... ,, ,, | £68 | ... |
| *c* Brass (rolled metal 9" to 12" basis) per lb. | 9¼d. | ... |
| *c* ,, Tubes (solid drawn) ,, ,, | 11¾d. to 1/- | ... |
| *c* ,, Wire, basis ... ... ... ,, | 9¾d. | ... |
| *c* Copper Tubes (solid drawn) ... ,, | 1/1½ | ... |
| *c* ,, Bars (best selected) ... per ton | £96 | ... |
| *c* ,, Sheet ... ... ... ... ,, | £96 | ... |
| *c* ,, Rod ... ... ... ... ,, | £96 | ... |
| *d* ,, (Electrolytic) Bars ... ,, | £71 15s. | ... |
| *d* ,, Sheets ... ,, | £145 10s. | ... |
| *d* ,, ,, Wire Rods ... ,, | £81 15s. | ... |
| *d* ,, ,, H.C. Wire per lb. | 10⅞d. | ... |
| *f* Ebonite Rod ... ... ... ... ,, | 3/6 | ... |
| *f* ,, Sheet ... ... ... ... ,, | 3/- | ... |
| *n* German Silver Wire ... ... ,, | 2/6 | ... |
| *h* Gutta-percha, fine ... ... ... ,, | 12/6 | ... |
| *h* India-rubber, Para fine ... ... ,, | 1/1½ | ... |
| *l* Iron Pig (Cleveland Warrants) ... per ton | 92s. 6d. | ... |
| *l* ,, Wire, galv. No. 8, P.O. qual. ,, | £24 | ... |
| *g* Lead, English Pig ... ... ... ,, | £28 | 10s. inc. |
| *g* Mercury ... ... ... ... per bot. | £11 to £11 10s. | 12/6 to 20/- inc |
| *e* Mica (in original cases) small ... per lb. | 3d. to 3/- | ... |
| *e* ,, ,, medium ... ,, | 4/- to 8/- | ... |
| *e* ,, ,, large ... ,, | 10/- to 20/- & up. | ... |
| *p* Phosphor Bronze, plain castings ,, | 1/1 | ... |
| *p* ,, drawn bars and rods ,, | 1/3 | ... |
| *p* ,, rolled strip & sheet ,, | 1/2½ | ... |
| *p* ,, wire ... ... ... ,, | 1/3½ | ... |
| *o* Platinum ... ... ... ... per oz. | £25 | ... |
| *d* Silicium Bronze Wire ... ... per lb. | 1/0½ | ... |
| *r* Steel, Magnet, in bars ... ... ,, | 10d. | ... |
| *n* Tin, Block (English) ... ... per ton | £178 to £179 | £3-£3 10s. dec. |
| *n* ,, Wire, Nos. 1 to 16 ... ... per lb. | 3/2 | ... |

**Quotations supplied by**

*a* G. Boor & Co.
*b* The British Aluminium Co., Ltd.
*c* Thos. Bolton & Sons, Ltd.
*d* Frederick Smith & Co.
*e* F. Wiggins & Sons.
*f* India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
*g* James & Shakespeare.
*h* Edward Till & Co.
*l* Bolling & Lowe.
*l* Richard Johnson & Nephew, Ltd.
*n* P. Ormiston & Sons.
*o* Johnson, Matthey & Co., Ltd.
*p* C. Clifford & Son, Ltd.
*r* W. F. Dennis & Co.

**Radio "Blind Spots" and Fading.**—According to *The Times*, several "freak" results have been observed since broadcasting began in this country. One problem is why the London programme should be heard faintly in Yorkshire and strongly in the North of Scotland—more strongly, in fact, than the Newcastle programme; and why Southampton and Portsmouth should hear the Manchester programme with ease and the London programme with difficulty. Furthermore, why should "blind spots" exist, where wireless signals cannot be heard at all? It would seem more fitting to call them "deaf spots." Several such places have been discovered in England. Didcot is one, Newbury another. The same problem has presented itself elsewhere. America has its "blind spots," and the Dutch Army authorities found it impossible to reach a certain area of four square miles by wireless signals. Geological conditions, contour, the presence of water, and atmospheric conditions are all believed to be influencing factors. It is believed that "fading" and "blind spots" are parts of one and the same problem. "Fading" is a known phenomenon, which is much more pronounced when a short wave-length is employed. This explains why English amateurs can often pick up Paris and The Hague messages with greater ease than British messages. When the wave-length is over 600 metres there is comparatively little "fading." The average wave-length of the British broadcasting stations is 400 metres. It has been found that "blind spots" vary and move with the alteration of the wave-length. Among other "freak" results recently registered was the receipt of the Newcastle programme at Gibraltar, and of the London programme on a crystal receiving set at Bridlington.

# THE WORK OF THE ELECTRICITY COMMISSIONERS.

## SECOND ANNUAL REPORT. *(Abstract.)*

(*Continued from page* 39.)

*General Observations.*—With regard to the provisional boundaries of electricity districts, there has been a disposition in some cases to regard the area as the "Commissioners' area," and for promoters to make this point when the adequacy or otherwise of their scheme for dealing with portions of an area has been called in question. As was pointed out in the previous Report, the Commissioners, before provisionally determining any electricity district, made a preliminary survey of the present and prospective electrical requirements of the area in contemplation, and due regard was then given to the potentialities of existing generating stations in the area and of their linking up; the probable location of future capital stations and the economical radius of transmission therefrom; the prospects of railway electrification and other transport extensions; the geographical trend of industrial development; the possibilities attaching to rural re-settlement, town-planning schemes, &c.; and to the question of the efficient administration of electricity supply throughout the area. The data available to the Commissioners in making such a survey, although sufficient to afford a *primâ facie* case for provisional determination, were not comprehensive enough to leave the question of area beyond doubt. As intimated in all notices of provisional determination, it has been open to the promoters of any scheme to include therein proposals for altering or adjusting the boundaries of a district in the light of the more detailed examination entailed in the preparation of their scheme.

The boundaries of a district have no necessary relation to local government boundaries, but the Commissioners have, in a number of cases, included the whole of a minor local government area, although little immediate advantage from an electrical standpoint was to be anticipated. Another aspect of the boundary question has been raised on several occasions, namely, the position of an authority whose area is on the fringe of a district and who may find, as the result of subsequent developments, that the balance of advantage is in favour of taking a supply from a source adjoining, but outside the district, or *vice versa*. The reply in such cases has been to the effect that a scheme for the re-organisation of supply in any district would not preclude an arrangement for a supply from an adjoining source if it were subsequently proved, to the satisfaction of the Joint Electricity Authority, or other public body for the district (or adjoining districts), and also to the satisfaction of the Commissioners, that such a course would be in the best interests of all concerned.

From inquiries received by the Commissioners in respect of areas which are at present without a supply of electricity, it would appear that the scope and intentions of the Act of 1919 have in many cases been misunderstood. There appears to have been a prevalent idea that the Commissioners themselves were engaged in carrying out a "national scheme" involving the construction of a number of super power stations from which supplies would be shortly available for all towns and villages requiring electricity. While the coming into operation of a scheme will improve the prospects of those areas at present without a supply, it will not necessarily result in supplies becoming immediately available in such areas.

The Commissioners have given much consideration to the question of supplies in "unoccupied areas" in connection with the framing of common form clauses for approved schemes. It is proposed to make provision in all District Orders (i) for the submission within a limited time by the Joint Electricity Authority or other public body set up by the Order of proposals for securing a supply in areas not forming part of the area of supply of any authorised distributor where there is a reasonable prospect of such supplies being remunerative; and (ii) for the carrying out within a definite time of such proposals to the extent approved by the Commissioners.

The bearing of schemes of re-organisation upon the position of private generating stations and of non-statutory undertakings giving a general supply, is another matter upon which the views of the Commissioners have been sought. In the case of private generating stations within the meaning of the definition in Section 36 of the Act of 1919, it appears to the Commissioners that the coming into operation of a scheme for a district will not affect the position of the owner, except with his consent, or the freedom of any consumers to continue to take a supply from the private station. On the other hand, the establishment in any district of a comprehensive distribution system should ultimately be to the benefit of such private stations by providing an outlet for surplus supplies generated during week-ends, &c., or by enabling the private station to take from the public system such supplementary supplies as might be required. The position of a non-statutory undertaking giving a general supply for lighting and other purposes would be somewhat different. In the event of the establishment of a Joint Electricity Authority, such authority would have power to distribute in areas not forming part of the area of supply of any authorised distributor, and it would thus be open to the authority to establish an undertaking in such area in competition with an existing non-statutory undertaking. Alternatively, it would be open to the Joint Authority to acquire the non-statutory undertaking.

It is an essential requirement of any engineering scheme for the re-organisation of the supply of electricity in a large district containing many authorised undertakers that there should be interconnection of the principal generating stations. The extent of the improvements and economies thereby rendered possible is dependent upon the extent to which the undertakers concerned are prepared to co-operate in the pooling of the resources of the interconnected stations for the common good.

A centralised system of generation in an electricity district can be brought about by the transfer to a Joint Authority of the generating stations and main transmission lines or interconnecting cables; or by conferring upon a Joint Authority or other public body set up in the district adequate powers of control over the working of the interconnected stations; or by an arrangement comprising partly one and partly the other method. From a review of the practical considerations that arise, it appears to the Commissioners that the vesting of the central supply system in a Joint Electricity Authority must result in the most satisfactory re-organisation of supply and lead to the maximum economies, provided that the transference be effected on reasonable terms. A considerable amount of evidence in favour of the principle was forthcoming at local inquiries. While the majority of the schemes hitherto submitted to the Commissioners have involved the setting up of Joint Authorities, three of them have provided for the establishment of advisory bodies. It appears to have been assumed in some instances that a Joint Electricity Authority could be set up against the wishes of the majority of the existing undertakers in a district; that the Authority would thus have to provide its own generating stations and main transmission lines; that the Authority would have no customers for a considerable time to come, except perhaps at the expense of the existing undertakers; and that in such circumstances all possibility of the Authority becoming a commercial success would be precluded. The setting up of a Joint Electricity Authority in the circumstances assumed premises a lack of co-operation, if not actual opposition, on the part of the undertakers in a district. It is overlooked that such co-operation is essential for the establishment of a Joint Authority and that the Act of 1919 provides that a Joint Authority must be representative of the authorised undertakers within an electricity district. Moreover, the lines upon which the re-organisation of supply in a district will proceed, as foreseen by the Commissioners, will probably be as follows:— (*a*) Generation and main transmission will be centralised under the *ægis* of a Joint Authority, the principal stations, forming the central supply system, being interconnected, and such new stations and main transmission lines as may be necessary being constructed as and when required to compensate for the shutting down of obsolete or inefficient stations, and to meet new demands; (*b*) local distribution and commercial development will remain in the hands of authorised distributors. In this event the authorised distributors represented upon the Joint Authority would constitute the principal customers supplied by that Authority and there would be no question of the Joint Authority being without customers or operating a system independent of and in competition with those of the existing undertakers in the district. The powers, duties and obligations conferred or imposed on Joint Electricity Authorities by the Act of 1919 will not be transferred to any other kind of public body proposed to be set up in an electricity district.

Correspondence has taken place between the Commissioners and the Ministry of Health upon the general question of the powers of a county council or local authority to contribute towards the expenses incurred in the preparation and submission to the Commissioners of a scheme for the re-organisation of supply in an electricity district provisionally determined under the provisions of Section 5 of the Act of 1919, and also upon the legality of the expenditure incurred by local authorities in sending representatives to local inquiries held by the Commissioners in connection with such schemes.

With regard to attendance at Local Inquiries the Commissioners have been informed that county councils and other local authorities concerned might incur reasonable expenditure in the preparation and submission of schemes for the re-organisation of supply, and for the purpose of attendance at local inquiries without obtaining the sanction of the Minister of Health. In the opinion of the Commissioners, it should be sufficient in ordinary circumstances for one representative of a local authority, with or without the electrical

engineer in the case of authorised undertakers, to attend at an inquiry, but that in cases where a local authority was tendering evidence it might be necessary for more than one member of that authority to be present. The Commissioners feel it necessary to place on record their appreciation of the detailed and thorough manner in which the schemes hitherto submitted to them have been prepared. The results reflect the greatest credit on all concerned, and have done much to facilitate the work of the Commissioners in the difficult and onerous duties laid upon them.

Comments have sometimes been made regarding the expense which falls upon authorised undertakers and others in connection with the preparation of schemes and the holding of the local inquiries. Having regard, however, to the importance and complexity of the problems at issue and to the number of interests concerned, the expenses necessarily incurred in the survey of districts, the preparation of the schemes, and the holding of inquiries are, in the opinion of the Commissioners, relatively small when compared with the economies thereby ascertained to be possible.

*Generating Stations and Main Transmission Lines.*—The industrial depression during the year 1921-22 has not been without its effect upon the number of applications made to the Commissioners for consent to the establishment of new generating stations and to the extension of existing stations, the plant capacity of the stations and extensions sanctioned during the year amounting to approximately 174,000 kW only, as compared with 697,000 kW for the preceding fourteen months ending March 31st, 1921. It must be noted, however, that the position was also influenced by the marked progress made during those fourteen months in overtaking arrears occasioned by the war and in meeting the requirements of the trade boom which followed immediately afterwards, and the provision thus made left many undertakers with an ample margin of plant when the depression commenced. The potential requirements of various electricity districts ascertained as the result of the detailed investigations made by the promoters of schemes submitted to the Commissioners, point to a period of great development upon the resumption of more normal conditions. The figures given in Table II,* by way of example, for eight of the provisionally determined electricity districts show the estimated requirements under normal conditions of industry, apart from potential demands for railway electrification.

TABLE II.

| Electricity District. | — | Figures for 1920-21. | Estimated figures for | |
|---|---|---|---|---|
| | | | 1926. | 1931. |
| Mersey and West Lancashire | M.D. (kW.) | 64,778 | 156,000 | 216,000 |
| | Units in millions | 193 | 460 | 638 |
| North Wales and Chester | M.D. (kW.) | 18,753 | 36,100 | 51,200 |
| | Units in millions | 50 | 95 | 135 |
| West Riding (Aire and Calder) | M.D. (kW.) | 102,458 | 210,000 | 299,000 |
| | Units in millions | 258 | 577 | 857 |
| London and Home Counties | M.D. (kW.) | 320,600 | 465,325 | 647,200 |
| | Units in millions | 608 | 1,013 | 1,500 |
| South-West Midlands | M.D. (kW.) | 92,649 | 149,950 | 214,250 |
| | Units in millions | 199 | 360 | 563 |
| South-East Lancashire | M.D. (kW.) | 185,077 | 432,230 | 643,730 |
| | Units in millions | 487 | 1,068 | 1,619 |
| North Lancashire & Sth. Cumberland | M.D. (kW.) | 4,627 | 10,820 | 14,610 |
| | Units in millions | 11 | 21 | 27 |
| North-West Midlands | M.D. (kW.) | 44,284 | 82,110 | 121,900 |
| | Units in millions | 117 | 205 | 285 |
| Totals ... | M.D. (kW.) ... | 833,226 | 1,542,435 | 2,207,089 |
| | Units in millions | 1,923 | 3,799 | 5,624 |

As compared with the position in 1920-21, the above figures indicate an estimated increase by 1926 of 709,209 kW in the maximum demand (85 per cent.) and of 1,876,000,000 units in the output (97 per cent.). By the year 1931 the estimates as compared with the figures for 1920-21 show increases of 1,374,664 kW in the maximum demand (165 per cent.) and 3,701,000,000 units in the output (192 per cent.). The estimates were for the most part framed before the set-back in trade had assumed a serious character, and this factor will have the effect of postponing the dates by which such increased demands will require to be met. Otherwise, there is little reason to doubt that future development will substantially accord with the careful forecasts made by the promoters of schemes and thus involve large additions to the plant capacity at present existing in the country.

It may be noted that a broad outline of the technical (engineering) scheme approved by the Commissioners for the reorganisation of the supply in any electricity district will be scheduled to the Order made by them under Section 7 of the Act of 1919. In general, the broad outline will cover the main developments to be undertaken during the first two quinquennial periods after the coming into operation of the Order, but with the object of providing a certain elasticity in the event of altered circumstances, provision will be made for enabling the main outlines to be varied or modified with the approval of the Commissioners.

The applications relating to the establishment of new generating stations which were under consideration by the Commissioners during the year ending March 31st, 1922, are dealt with below, a summary of the action taken on each being given.

The application of the County of London Electric Supply Co., Ltd., for consent to establish a generating station having an installed capacity of approximately 100,000 kW on a site at Barking, had been the subject of a detailed investigation by the Commissioners during the period covered by the last Report. After consideration of the evidence given at the local inquiry in respect of the several schemes for the London and Home Counties District and of the case submitted by the company in support of its application, the Commissioners came to the conclusion that the proposed station at Barking should be proceeded with, and made an announcement accordingly in their statement of decisions dated December 8th, 1921.

In June, 1921, the Preston Corporation applied for a Special Order to authorise, *inter alia*, the supply of electricity by the Corporation in the Borough of Preston, &c., the acquisition of the existing undertaking of the National Electric Supply Co., Ltd., and also the use of certain land on the River Ribble for the purpose of constructing a new generating station. The present and prospective requirements of the borough were investigated, and the Commissioners came to the conclusion that a case had been made out for the erection of a new station, apart from any further provision that might ultimately be found necessary in connection with the reorganisation of supply in the Mid-Lancashire Electricity District. In January, 1922, the Corporation was notified by the Commissioners that their consent to the establishment of a new station to contain initially 20,000 kW of generating plant would be issued when the Special Order referred to above had been approved by Parliament. The Order was so approved on March 15th, but certain requirements of the Commissioners remained to be complied with by the Corporation.†

The proposals of the Salford Corporation to erect a new generating station at Agecroft were under consideration by the Commissioners during the period covered by the previous report, and conferences had been held with representatives of the Corporation as to the conditions to be attached by the Commissioners to any consent given. These conditions related to the terms upon which the proposed station, if erected, could be acquired by a Joint Electricity Authority if such a body were established for a district including the County Borough of Salford. The question of conditions formed the subject of further correspondence between the Commissioners and the Corporation after April 1st, 1921, but after consideration of the changed circumstances since the date when the question of conditions was first raised, the Commissioners notified the Corporation in November, 1921, that they were prepared to consider giving their consent without attaching any conditions as to purchase, subject to the requirements of the Commissioners with regard to applications for consent to establish new generating stations being complied with.

*(To be continued.)*

**Novel Meter Reading.**—An innovation in meter reading, by means of which a photograph of each meter face is taken, has been recently adopted on the Toronto Hydro-Electric System. So far, this system has only been used on demand wattmeters, but it is quite applicable to any meter on the company's lines. The great point of the system is that the meter is read with photographic fidelity, and an indisputable record is brought to the office files. There have been no disputes in this case, but if such should occur, the records are at hand, being the means of transporting monthly to the office shelves all the meters on the company's mains.

The photographs are taken with a special camera, equipped with an anastigmat lens of short focus, a simple automatic shutter controlled by the operator, making exposures with varying speeds as fast as one-fifth second, and lamps for furnishing light for the exposure. The actual photograph is obtained with the front of the camera against the meter dial by pressing downward an exposure lever. This action automatically turns on the light, opens and closes the shutter, automatically locks until the film for the next exposure is automatically locks until the film for the next exposure is wound into place. This prevents the possibility of a double exposure; that is, the superimposing of one exposure upon another. Identification of the meter is obtained by stamping on the outside of the glass dial the meter number. The light is furnished by two four-cell dry batteries stored in either side of the camera, supplying current to four 3.8-volt Mazda miniature lamps.—*Electrical News.*

* NOTE.—The above table was compiled from the figures put forward by promoters in the schemes submitted by them to the Commissioners. Some of the figures are based on "units generated," some on "units sent out," and some on "units sold."

†The Commissioners issued their formal consent on May 11th, 1922.

# THE TRADE OUTLOOK IN CHINA.

## (With Import Trade Statistics.)

BRITISH trade prospects in China are brighter than they have been for some time, according to the recently-issued report* of Mr. H. H. Fox (H.M. Commercial Counsellor at Peking). July, 1922, is the date up to which the report is written, and the optimistic statement is made after full consideration of the disturbed political and financial conditions which have so long prevailed in China. Though this state of affairs has not greatly improved since July, it may be fairly said that things are no worse.

The commercial and industrial development of the country has, of course, been retarded, and at times been brought to a complete standstill, yet trade has been carried on in the face of almost insurmountable difficulties, and the statistical records of China's foreign commerce in 1921 are a striking example of the extraordinary vitality and power of recuperation inherent in the Chinese.

**German Methods.** H.M. Commercial Counsellor comments on the efforts of German traders to recover their former position in the Chinese market. It is noteworthy that they often work in partnership with Chinese and under Chinese names. This is a long step in that co-operation between foreign and Chinese interests which Professor Middleton Smith has frequently advocated in these columns. In engineering some well-known German firms have secured important contracts for industrial plant, such as electric power and telephone equipment, cement making, and mining machinery.

Mention is made in the report of the handicap which the Germans were suffering in the matter of deliveries owing to the difficulty in obtaining materials and the unsettled manufacturing conditions at home. These difficulties have, of course, since grown. It is characteristic of German methods that in 1921 they were not confining themselves to the sale of German goods nor were they averse from dealing with British and other foreign firms.

**Industrial Movement.** The movement towards the promotion of manufacturing industries, whether by Chinese solely or by co-operation between them and foreign experts, has not progressed commensurately with the material resources of the country. The disturbed conditions generally are chiefly to blame, but rashness and lack of experience on the part of all but a small minority are contributory causes. Before the industrial progress of China can have any marked effect on the world's trade it is obvious that there will have to be a settled civil government controlling the whole country, a systematic development of transportation, a scientific improvement in the production of cotton, tobacco, silk, and other of her raw materials, a stable currency and, finally, some measure of fiscal reform. The Commercial Counsellor adds that, unfortunately, the prospects of so many desiderata becoming accomplished facts are extremely remote. When all the present difficulties have been overcome many competent observers believe that China's industries will pass increasingly into the hands of the Chinese themselves, who will learn by experience the lessons of efficient and far-sighted management.

This question of the future industrialisation of China adds interest to the section of Mr. Fox's report which deals with labour conditions. The Commercial Counsellor admits that he did not forsee the seamen's strike at Hong Kong, and adds that it need not be taken as a manifestation of industrial unrest on the part of Chinese workers as a whole. It will encourage the professional agitators who control the majority of the recently-formed labour unions and associations, but there is reason to believe that the danger is realised by the settlement authorities and the large employers of labour, both foreign and Chinese, who are taking measures to cope with any emergencies.

In Shanghai, Mr. Fox says, the question of transportation to and from the factories is becoming urgent, and the best solution would appear to be an extension of the electric tramway system to outlying villages, where workmen's houses might be built by the millowners.

**Set-back in Railways.** Railways have had a chequered career during the period under review. So, too, have many firms who sought to assist in their extension. Whereas at the end of 1920 the financial position of the railways was sound, they were undermined during 1921 by reckless orders for new equipment and by withdrawals of cash purchases from the railways to meet the demands for money for provincial military leaders. These circumstances, combined with interference with traffic, resulted in the railways closing their books at the end of 1921 with bills outstanding to foreign firms of over $50,000,000. It is stated that fortunately British firms have not figured largely in these transactions.

*Department of Overseas Trade. Price 1s. 9d.

Letters are constantly received at the Commercial Counsellor's office from manufacturers of railway material in the United Kingdom asking for the names and addresses of the directors of the various Chinese Government railways, or asking H.M. representative to bring their specialities to the notice of the railway officials concerned. The reply is that, in view of very keen international competition, it is quite hopeless for any firm not represented in China to expect to share in any orders that may be going.

As time goes on and the country settles down, efforts will, no doubt again be made to provide China with the railways it so badly needs. Meanwhile, manufacturers should get into communication with the big merchant houses on the spot. Through them opportunities may also arise for supplying plant and equipment for the many industries which are springing up in Shanghai, Tsingtao, Tientsin, and Hankow. These industries are described in some detail in Mr. Fox's report. In addition to cotton spinning and weaving there are carried on: albumen factories, canneries, carpet factories, cement and brick works, chemical and dye works, shipbuilding and engineering works, electric light and power stations, flour mills, iron and steel works, potteries, oil mills, &c.

**Coal and Iron.** Of coal—that most important factor in industrial expansion — China produced nearly 20,000,000 tons in 1921, and has reserves which are estimated at between 40 and 50 billion tons.

China's iron resources have been consistently exaggerated. The iron reserves of the country, as based on six years of study of the question by the Geological Survey, are given as 677,000,000 tons, distributed principally as follows:—91,000,000 in Chihli Province. 387,000,000 in South Manchuria, 23,000,000 in Shangtung, 160,000,000 in the Yangtse Valley provinces, and 7,000,000 in Fukien. These figures represent only such known deposits as have been already studied by the Survey, and cannot be taken to be the total existing reserve, which may be possibly twice as much, or at a conservative estimate, 1,000,000,000 tons. The present production of iron ore in China is some 1,500,000 tons, of which about two-thirds is smelted in the country. There are now eight ironworks in the country constructed or under construction, with a total output equal to some 1,000,000 tons, but progress in this direction during the past year has not been marked. The exports of iron ore decreased from 11,292,407 piculs in 1920 to 8,517,162 piculs in 1921. Still more than in the case of her coal deposits, the development of China's iron industry is hindered by lack of the means of transportation for bulky raw materials over large distances.

Generally speaking, it may be said that mainly owing to disturbed political conditions in China and, in a measure, to the world-wide trade depression, the local engineering trade is passing through a somewhat critical period, and even the firms who secure the largest share of the business are finding it no easy matter to make enough to pay for their necessarily heavy overhead expenses. At the same time, the engineering business in China, if one of the most difficult to carry on successfully, holds out greater possibilities than perhaps any other, and when the long-expected trade revival does come Mr. Fox is confident that those British manufacturers who have been at pains to arrange for suitable representation in the country will reap the benefit of their faith in the future of the China market.

**Electric Light and Power.** The Customs report for 1921 shows that the importation of electrical materials and fittings rose from 6.3 million taels in 1920 to 13.2 millions in 1921. Adverse trade conditions caused a marked decline in the sale of small lighting plants, which is partly ascribed to the installation of new, or the improvement of existing plants for public light services. Many contracts for large power and light plants for cities in the interior were settled, and there is an increasing tendency to install larger sets of 1,000, 2,000, and 5,000 kilowatts, while only a couple of years ago 200 and 400-kW sets were considered sufficient to meet requirements. These installations are bound to have an effect on China's industrial progress. It is interesting to note that a Sino-German company purchased during the past year a large quantity of land near Soochow whereon to commence the manufacture of motors and electrical appliances, this being the first project of this nature to be mooted in China.

## IMPORT TRADE OF CHINA.

THE following table shows the value (and where possible the weight) of China's imports in 1921 of material of interest to the electrical and allied trades, indicating the principal countries of origin. The figures for 1920 are given in comparison, and notes of increases or decreases are added. It is probable that the trade credited to Hong Kong was to a fair extent transacted with the United Kingdom.

The Chinese picul=133⅓ lb. average, and the Haikwan tael=6s. 9½d. in 1920 and 3s. 11½d. in 1921.

| Country whence imported. | | 1920. | 1921. | Inc. or dec. |
|---|---|---|---|---|
| *Aluminium, manufactured.*— | | | | |
| Total ... ... | piculs | 44,500 | 35,500 | + 9,000 |
| | taels | 70,000 | 60,000 | − 10,000 |
| Japan ... ... | piculs | 613 | 510 | − 103 |
| | taels | 45,000 | 40,000 | − 5,000 |
| United States... | piculs | 265 | 40 | − 225 |
| | taels | 15,000 | 5,000 | − 10,000 |
| *Brass and yellow metal; bars, sheets, wire, &c.*— | | | | |
| Total ... ... | piculs | 1,040 | 760 | − 280 |
| | taels | 1,224,000 | 1,239,000 | + 15,000 |
| Hong Kong ... | piculs | 10,900 | 15,000 | + 4,100 |
| | taels | 318,000 | 483,000 | + 165,000 |
| Great Britain... | piculs | 15,470 | 4,000 | − 11,470 |
| | taels | 298,000 | 177,000 | − 121,000 |
| Japan ... ... | piculs | 16,500 | 15,000 | − 1,500 |
| | taels | 505,000 | 506,000 | + 1,000 |
| Canada ... ... | piculs | 14 | — | − 14 |
| | taels | 1,000 | — | − 1,000 |
| United States ... | piculs | 1,980 | 300 | − 1,680 |
| | taels | 81,000 | 17,000 | − 64,000 |
| Russia ... | piculs | — | 700 | + 700 |
| | taels | — | 41,000 | + 41,000 |
| *Copper, bars, rods, sheets, plates, nails, and wire.*— | | | | |
| Total ... ... | piculs | 60,000 | 27,000 | − 33,000 |
| | taels | 1,900,000 | 1,040,000 | − 860,000 |
| Hong Kong ... | piculs | 810 | 500 | − 310 |
| | taels | 26,000 | 17,000 | − 9,000 |
| Great Britain | piculs | 3,000 | 3,400 | + 400 |
| | taels | 94,000 | 165,000 | + 71,000 |
| Japan ... ... | piculs | 55,000 | 22,000 | − 33,000 |
| | taels | 1,768,000 | 786,000 | − 982,000 |
| Canada ... | piculs | 122 | — | − 122 |
| | taels | 3,000 | — | − 3,000 |
| United States ... | piculs | 6,000 | 1,100 | − 4,900 |
| | taels | 22,000 | 49,000 | + 27,000 |
| *Electrical materials and fittings.*— | | | | |
| Total ... ... | taels | 6,515,000 | 13,204,000 | + 6,689,000 |
| Hong Kong ... | taels | 319,000 | 496,000 | + 177,000 |
| Great Britain... | taels | 954,000 | 3,418,000 | + 2,464,000 |
| Italy ... ... | taels | 39,000 | 114,000 | + 75,000 |
| Japan ... ... | taels | 2,624,000 | 3,140,000 | + 516,000 |
| Canada ... | taels | 304,000 | 378,000 | + 74,000 |
| United States... | taels | 2,012,000 | 4,658,000 | + 2,646,000 |
| Sweden ... | taels | 25,000 | 112,000 | + 87,000 |
| Belgium ... | taels | 27,000 | 260,000 | + 233,000 |
| Holland ... | taels | 50,000 | 81,000 | + 31,000 |
| France ... | taels | 12,000 | 72,000 | + 60,000 |

| Country whence imported. | | 1920. | 1921. | Inc. or dec. |
|---|---|---|---|---|
| *Machine belting.*— | | | | |
| Total ... ... | taels | 1,540,000 | 1,085,000 | − 455,000 |
| Hong Kong ... | taels | 78,000 | 87,000 | + 9,000 |
| Great Britain... | taels | 645,000 | 302,000 | − 343,000 |
| Japan ... ... | taels | 264,000 | 298,000 | + 34,000 |
| United States... | taels | 521,000 | 337,000 | − 184,000 |
| Russia ... ... | taels | — | 70,000 | + 70,000 |
| *Machine tools.*— | | | | |
| Total ... ... | taels | 761,000 | 931,000 | + 170,000 |
| Great Britain... | taels | 111,000 | 296,000 | + 185,000 |
| Denmark ... | taels | 1,500 | 7,000 | + 5,500 |
| Japan ... ... | taels | 317,000 | 293,000 | − 24,000 |
| Canada ... | taels | 22,000 | 7,000 | − 15,000 |
| United States... | taels | 284,000 | 271,000 | − 13,000 |
| Germany ... | taels | 5,000 | 34,000 | + 29,000 |
| *Propelling machinery such as boilers, turbines.*— | | | | |
| Total ... ... | taels | 2,376,000 | 5,109,000 | + 2,733,000 |
| Great Britain... | taels | 1,018,000 | 3,351,000 | + 2,333,000 |
| Japan ... ... | taels | 202,000 | 255,000 | + 53,000 |
| Canada ... | taels | 140,000 | 53,000 | − 87,000 |
| United States... | taels | 655,000 | 998,000 | + 343,000 |
| Sweden ... | taels | 31,000 | 44,000 | + 13,000 |
| Germany ... | taels | — | 115,000 | + 115,000 |
| Belgium ... | taels | 5,000 | 281,000 | + 276,000 |
| *Machinery, other, not textile, brewing, refining, &c.*— | | | | |
| Total ... ... | taels | 12,444,000 | 21,000,000 | + 8,556,000 |
| Hong Kong ... | taels | 426,000 | 960,000 | + 534,000 |
| Great Britain... | taels | 2,172,000 | 6,459,000 | + 4,287,000 |
| Japan ... ... | taels | 2,122,000 | 2,396,000 | + 274,000 |
| Canada ... | taels | 400,000 | 528,000 | + 128,000 |
| United States... | taels | 6,774,000 | 7,516,000 | + 742,000 |
| Sweden ... | taels | 56,000 | 322,000 | + 266,000 |
| Denmark ... | taels | 45,000 | 1,458,000 | + 1,413,000 |
| Germany ... | taels | 61,000 | 681,000 | + 620,000 |
| Belgium ... | taels | 22,000 | 346,000 | + 324,000 |
| France ... ... | taels | 34,000 | 129,000 | + 95,000 |
| Russia ... ... | taels | 146,000 | 205,000 | + 59,000 |
| *Telegraph and telephone material.*— | | | | |
| Total ... ... | taels | 1,889,000 | 1,641,000 | − 248,000 |
| Hong Kong ... | taels | 25,000 | 45,000 | + 20,000 |
| Great Britain... | taels | 365,000 | 367,000 | + 2,000 |
| Japan ... ... | taels | 1,150,000 | 322,000 | − 828,000 |
| Canada ... | taels | 73,000 | 40,000 | − 33,000 |
| United States... | taels | 202,000 | 297,000 | + 95,000 |
| Sweden ... | taels | 22,000 | 171,000 | + 149,000 |
| Germany ... | taels | 3,000 | 143,000 | + 140,000 |
| Belgium ... | taels | 18,000 | 225,000 | + 207,000 |

# TYNESIDE TRAMWAY DEVELOPMENT.

## Linking-up of Newcastle and Gateshead.

THE opening to-day of the section of tramway which has been laid across the high-level bridge which spans the River Tyne between Newcastle and Gateshead marks an epoch in electric traction, the importance of which is out of all proportion to the extent of the section itself.

The bridge is an historic structure, for it was built between 1846 and 1849, by Robert Stephenson, in order to render possible a through railway journey between the north and south of England. It is formed of six cast-iron arches and the length of the viaduct is about 440 yards; the tramway lines just laid are about 85 ft. above the high-water mark of the river. Although constructed at a time when railway rolling stock was relatively light, the bridge has served, until quite recent years, for all the railway traffic on the north-east coast route, not excluding the "Flying Scotsman." The main railway line is carried on the top deck of the bridge, 112 ft. above high-water level, and the lower deck of the bridge is hung from the main girders and carries the Great North Road, which on this side of the country links up England and Scotland. It is on the lower deck that the tramcars are running. For some necessary reconstruction work the bridge was closed for a month; the old roadway was taken up, and the wooden beams were replaced by steel girders, which have strengthened the structure and will enable it to bear the largest 15-ton cars when fully laden.

It will thus be seen that the opening of the tramway section over the bridge bears a marked analogy to the opening of the bridge for its original purpose—the connection of northern and southern traffic.

Primarily the junction formed is between the City of Newcastle Corporation tramways and the system in the southern borough, owned by the Gateshead and District Tramway Co., but there is every possibility that the "through service" will be developed considerably as time goes on. The accompanying map shows the extent of the area covered by the interlinked services, and demonstrates how electric traction has been continued by various motor 'bus services—some run in conjunction with the tramway and others run independently.

The Newcastle tramway system extends to some 76 miles of single track, and the Corporation has running powers over more than six miles of the track of the Tyneside Tramways and Tramroads Co., while recent Parliamentary Bills and Light Railway Orders authorised a further 17½ miles of single track to be constructed. Some of the extensions are in course of construction, but the most important item included in the powers mentioned was the linking-up of the City and the Gateshead systems. The Corporation's rolling stock consists of 80 double-truck double- and single-deck cars, 156 single-truck cars, and 4 sets of coupled-cars; there are also 18 motor coaches, and seven double-deck 'buses. Whereas the original plant was d.c. at 550 volts with a capacity of 5,100 kW, the present plant consists of two 3,000-kW and one 4,000-kW Parsons turbo-alternators, and two 650-kW vertical Corliss engines and dynamos, the total plant capacity being 11,300 kW. Electricity is generated at 6,600 volts, and there is 6,900 kW of rotary converter plant, with transformers at the power station and sub-stations. Mr. Ernest Hatton is the engineer and general manager of the Corporation undertaking.

The City tramway system is by far the most important on Tyneside, and the routes extend from the Wallsend boundary on the east of the City to Throckley on the west, a distance of about eleven route miles. Northward the system reaches

to Gosforth, three miles, and thence over the Tyneside Co.'s track to Gosforth Park. Other main routes are shown on the map traversing the main west road, another to Benton

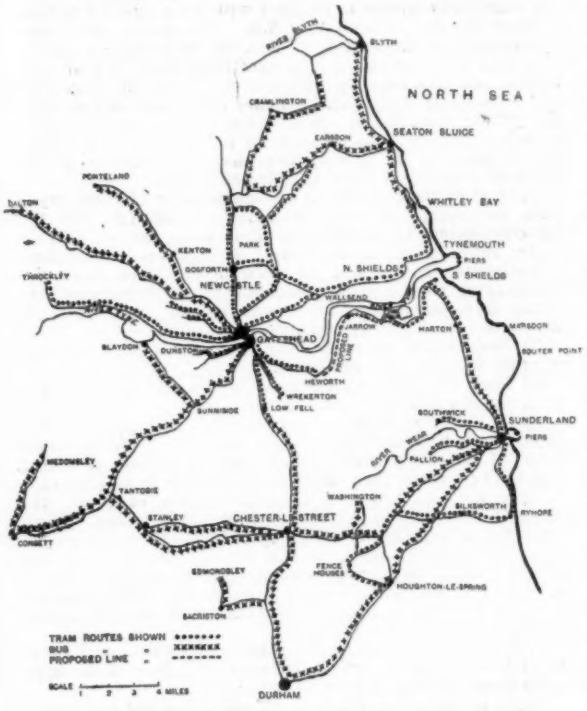



FIG. 1.—TYNESIDE TRAMWAY SYSTEMS.

on the North-East, while other routes stretch out fan-wise into all the residential areas.

On the south side of the river the area is well served by a network of lines which reach in several instances to the borough boundary. The main routes are:—Low Fell, 2.49 route miles; Heworth, 2.54 miles; Wrekenton, 3.22 miles; Sheriff Hill, 1.83 miles; Bensham, 1.72 miles; Saltwell Park, 1.75 miles; and Dunston, 1.90 miles. Mr. W. Morrison is the manager and resident director.

The Northern General Transport Co. which embraces the tramway system, has developed motor transport in connection with the local tramway services to a notable extent, and has also inaugurated independent services. Mr. H. A. Stagg is the resident director and secretary of the Transport Co.

From the centre of Gateshead a tramway route extends to Heworth, in an easterly direction, and but for a small gap between the Heworth terminus and the commencement of the Jarrow Co.'s system there is a line of tramway to the seaside at South Shields. The Jarrow Company's tramways are linked up with those of the South Shields Corporation, the latter system extending to Harton on the Sunderland Road. The 'buses of the Northern Transport Co. supplement this service and continue it into Sunderland. This borough has an excellent service of tramways that is joined up at its southern extremity with the Sunderland & District Tramways Co., the tramcars of which give access to the great mining community around Houghton-le-Spring, Fence Houses, Silksworth, Ryhope, and other places in the immediate vicinity.

Returning to the area to the north of the Tyne, it may be noted that to the east of the city and beyond the boundary the tramway line is continued through Wallsend, Willington Quay, to North Shields by the Tyneside Tramway & Tramroad Co., where the line terminates, but a few yards away the traveller to the coast can continue his journey by the cars of the Tynemouth & District Electric Tramways Co., which pass through Tynemouth, Cullercoats, to Whitley Bay and Monkseaton. Thence to the thriving seaport of Blyth, to the north, an adequate motor service carries passengers at frequent intervals. It is a cause of regret that the gauge of the Tyneside Co. and those of the Tynemouth Co. are dissimilar, otherwise it would have been possible for pleasure seekers from the extreme west of Newcastle, or most distant parts of the Gateshead system, to reach the coast without a change of car.

At the time of writing the arrangements for inter-running between Gateshead and Newcastle had not been announced; but it is understood that cars from all the Gateshead routes will run into the city, greatly to the convenience of the public.

The opening of this high-level bridge section, small as it may appear when measured superficially, is full of interesting possibilities for the future.

# VARIABLE-SPEED A.C. MOTORS

## (Without Commutators).

By F. CREEDY, A.M.I.E.E.

(*Abstract of lecture delivered before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

FOLLOWING a brief general discussion of the difficulties of designing a satisfactory variable-speed a.c. motor, a new method of pole changing is described. At 50 periods between the speeds of 375 r.p.m. and 1,000 r.p.m. there are six numbers of poles available.

One method by which they might theoretically be rendered available with a single-winding is the use of a ring winding tapped at the various points necessary to give different numbers of poles. In order to overcome the necessity for a very large number of terminals, the method of pole changing was adopted that is shown in figs. 1 and 2.

Imagine the 12 sections of the ring winding (fig. 1) to be carrying currents differing in phase from one another by 60 deg., the current vectors being shown on the right of fig. 1 (*b*), the current in section 1 having a phase 0 deg., that in section 2 having a phase 60 deg., that in section 3, 120 deg., and so on. These vectors when projected on a vertical axis give the instantaneous currents in the different sections, which may be plotted as shown on the left of fig. 1 (*b*). We thus obtain a series of ordinates the extremities of which lie on a sine curve, having two positive and two negative maxima, *i.e.*, four poles on the circumference. If, however, we so reconnect these sections that the phase difference between adjacent sections is 30 deg. and plot out the ordinates as in fig. 1 (*a*), we obtain another sine curve having one positive and one negative maxima, *i.e.*, two poles, while if we make the phase difference between the sections 90 deg., as in fig. 1 (*c*), we obtain a curve having three positive and three negative maxima, *i.e.*, six poles.

Fig. 3 shows the connections whereby this change of phases may be accomplished for the case of 13 phases. It involves the use of 13 terminals on the motor (still shown as a ring winding) and some means of producing a number of phases (*viz.*, 13) equal to the number of sections in the motor winding. This involves some means of converting from the usual three-phase supply to the number of phases required by the motor and a new piece of apparatus, the phase transformer, or converter, is required with this method of control. It may appear as if we had merely simplified the switching by introducing another piece of apparatus which will cost as much as the switchgear with which we have dispensed. This is far from being the case.

It is possible to reduce the number of terminals in several ways. Wherever we have currents differing by 180 deg. in phase (mutually reversed) it is not necessary to supply two distinct phase-transformer terminals to obtain these two phases. If the two sections are connected in series or parallel, mutually reversed, they can be supplied from a single terminal.

The reversal and star-mesh methods may be combined to obtain windings in which the e.m.f. across the sections has four times as many phases as that supplied to the terminals, not on one number of poles only, but over a large series of numbers covering a speed range of 3—1 or more, without reconnecting the winding in any way when changing the numbers of poles. This winding is shown in fig. 3 for 36 sections, 18 of which are connected in mesh and an equal number connected in star to the angles of the mesh, alternate sections in the mesh being mutually reversed, and alternate sections in the star being also mutually reversed, the mesh sections alternating with the star sections around the circumference of the machine.

This winding (containing only 18 terminals) is being frequently used on all numbers of poles from 6 to 16 and is, with a slight further modification, also capable of being used on further numbers of poles from 20 to 26. It also gives an approximately constant flux on all numbers of poles.

A further simplification is possible where only odd numbers of pairs of poles are required and diametrically opposite sec-

tions are always opposite in phase on every number of poles which a machine is required to give, and may be permanently connected in series, mutually reversed, as shown in fig. 4; it has only 9 terminals, capable of operating on 2, 6, 10 and 14 poles and, with a slight further modification, on 22 and 26 poles. This winding is the simplest known multi-speed winding. It requires no more than 9 phases, while the original winding may require 18 phases.

*Phase Converter.*—When a single motor is operated from a generator which serves no other purpose, as in ship propulsion, no phase transformer is needed, as there is no difficulty in winding the generator for the number of phases required. This transformer does not differ externally in any way from the standard three-phase core-type transformer. The connections, however, are as shown in fig. 5, in which all the windings shown by lines parallel to one another are considered to be wound on the same limb of the transformer. Since the windings are drawn parallel to three straight lines at 120 deg., only three such limbs are needed.

If we take a three-phase transformer having two secondary sections on each limb, and connect these sections in the

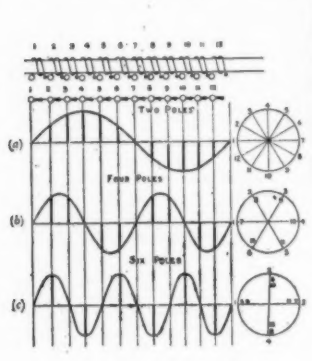



FIG. 1.

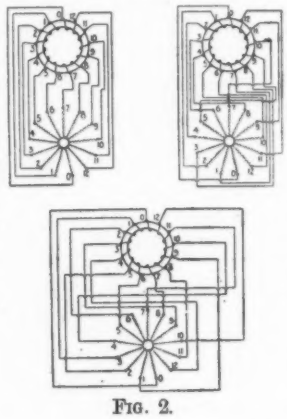


FIG. 2.

manner shown, six-phase currents may be derived by bringing out terminals from the corners of the hexagon. If, however, we tap the sides of the hexagon in the manner shown, winding on the three limbs (in addition) six small auxiliary sections to be connected to the corners of the hexagon, it is possible without further elaboration to obtain no less than 18 phases, the tappings shown in the diagram lying in a circle.

If no voltage transformation is needed, as in this case, a separate primary is not needed, for the primary terminals may be connected direct to alternate corners of the hexagon, or (to save extra terminals) to the extremities $L_1$, $L_2$, $L_3$, of three of the small, auxiliary, sections wound on the transformer and corresponding to the secondary terminals $T_1$, $T_7$, $T_{13}$.

By using the apparatus as an auto-transformer in this way we at once abolish the whole of the primary windings and, therefore, double the rating of a transformer of a given size. We do more than this, in fact, because the primary and secondary currents flowing in opposite directions in the same windings give a resultant which is very materially less than the secondary current alone.

As a result a phase transformer to transform a given amount of power, say, from 3 to 9 or 18 phases, will require a size of transformer of only between 30 and 40 per cent. of the rating of the transformer which will be required to convert the same amount of power, say, from one voltage to another.

Another economy which still further reduces their capacity can be effected. In a constant-torque motor giving a horse-power proportional to the speed, the amount of power taken will also be approximately proportional to the speed. If the motor winding be directly connected to the line when operating at 1,000 r.p.m., the phase converter not being used on that speed but coming into operation for the first time only at 750 r.p.m., we shall be able to reduce its capacity to 0.75 times the value which would be needed to supply the power required at 1,000 r.p.m. As a result the rating of such a transformer may be only from 18 to 22 per cent. of the rating needed to handle the maximum power taken by the motor at top speed. It forms, therefore, by no means an expensive item in the equipment, much less so, in fact, than the transformer required with many types of variable-speed commutator motor.

*Controller.*—Different types of controller are required for different speed combinations.

A three-phase multi-speed motor for any number of speeds up to six, will require three times as many terminals as there are speeds. That is, a multi-speed motor with a single winding on each member may be built for any number of speeds up to six, requiring no more terminals than if each speed were produced by a different winding. Speed ranges at 50 periods, covering practically everything that is needed for industrial purposes, are sufficiently simple to be dealt with by a drum controller suitable for motors up to 200 h.p. The larger sizes need apparatus of a different type built by the Electric Construction Co., Ltd., consisting of a slate panel bearing four nine-bladed, two-way switches with vertical axes of the finger-type and bearing on studs. The switches are opened and closed in the proper sequence by cams. For each speed two of the switches make contact, thereby connecting the 18 terminals of the motor to the line or the phase transformer, in the different ways appropriate to different speeds.

One half of the connections for one number of poles, say 8, with the machine running clockwise, are identical with half the connections for another number of poles, say 10, with the motor running counter-clockwise. It conduces to simplicity of switching, therefore, if we make no change in connections in changing from 8 to 10 poles, but merely interchange two of the three-phase lines, by means of the two contactors which perform a quadruple function:—

(1) They reverse the three-phase connections when required, in order to economise switching.

(2) They are fitted with overload relays, so that they perform the function of a circuit breaker.

(3) In changing from one speed to the next in any multi-speed motor it is necessary to open the circuit, which in most forms of switchgear gives rise to a certain amount of arcing.

(I have for many years made it my practice in all such cases to open the circuit first by a special switch designed with adequate blow-out apparatus, &c., to avoid arcing. Then, while the motor circuits are completely dead, to change the connections, which may, of course, be done without any arcing, because they are not carrying any current. And, lastly, to close the main circuit again through the switch specially provided for that purpose. The contactors on the control panel perform this function also.)

(4) A small switch opens the contactor magnets, and causes them to act as a line switch, isolating the whole of the apparatus from the line as soon as it is opened.

The connections on the back of the board are not unduly complicated and a mechanical interlock is fitted between the contactors and the cam shaft. A slight movement of the controller handle opens the contactor magnets. No further movement is possible until both the contactors are fully opened. When this has taken place the shaft is freed, and on moving it further the cams alter the adjustment of the main switches. When the handle of the controller has moved, say, 180 deg., then the adjustment has been completed and the magnetic circuit of the contactors is re-energised, closing them when the machine continues to operate on the new number of poles. These operations do not, in practice, take more than two seconds.

*Characteristics of the Equipment.*—With squirrel-cage motors having a speed-range of two to one, or more, it is always possible to obtain full-load starting torque with not more than twice full-load current, but if switched straight on to the line large machines frequently take much greater current and give correspondingly greater torques. In most cases, therefore, the use of an auto-transformer is necessary with large machines.

FIG. 3.

FIG. 4.

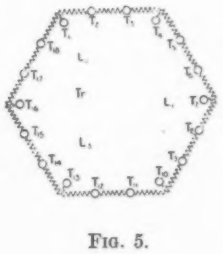


FIG. 5.

Both the current-rush on changing speed and the rate of acceleration from one speed to the next are under exact control by the use, in series with the motor, of primary resistance, which reduces the voltage during the change of speed. To make use of this method of regulating the rate of acceleration between speeds there is fitted on the control panel a third contactor, which opens when the other two open, and closes, due to the action of a dashpot, a few seconds after they close, and bridges three resistances, each placed in series with one of the lines; hence, directly the contactor opens, these resistances are placed in circuit, being adjusted to produce any desired rate of acceleration. They remain in series with the line during the operation of changing speeds, and are cut out when this operation has been completed. Substituting an auto-transformer for the resistance reduces the maximum current-surge to about one-half. In a motor

having a wide speed-range the lowest speed-steps are very small, and there is seldom any need for such a device; for high speeds, however, it is needed.

This method of starting and changing speed can be employed for motors up to several hundred horse-power, and renders the squirrel-cage motor adaptable to a vast variety of purposes for which it has never been found possible to use it before. A further extension of its field may be obtained by the use of centrifugal clutches, arranged to operate at the lowest speed of the motor, the speed-change from this point being arranged in the manner just described.

Fig. 6 is a series of circle diagrams for such a multi-speed motor operating on all numbers of poles from 6 to 16 and absorbing the same magnetising current in all cases, assuming that the leakage coefficient is proportional to the number of poles, thus being twice as great in a 12-pole machine as in a 6-pole one. This assumption is very nearly fulfilled in this type of machine. This figure shows clearly the cause of the very great economy in starting current. With 16 poles the motor takes about one-third of the starting current required with a 6-pole connection. Since the motor gives the same torque at all speeds, the ordinates to each circle represent the torque to a scale such that the torque represented by 1 mm. on the diagram is proportional to the number of poles. Hence, in spite of the small current consumption, the motor can yield a powerful starting torque at the lowest speed.

*Slip-ring Motors.*—It is possible to design a rotor winding for a machine having any number of speeds which shall give genuine slip-ring control up to one of these speeds, for instance, the top speed, and operate as a short-circuited secondary winding on all other speeds. One convenient way of effecting this result is by using such a winding as is shown in fig. 3, but permanently connected so as to be capable of direct connection to the line, fig. 7, when it requires no more than three terminals, and can be connected to the usual number of slip-rings.

On all other numbers of poles than six, however, the winding would require more than three terminals to enable it to

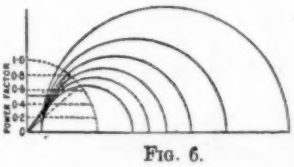



FIG. 6.

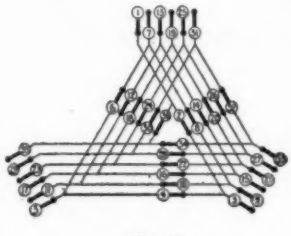


FIG. 7.

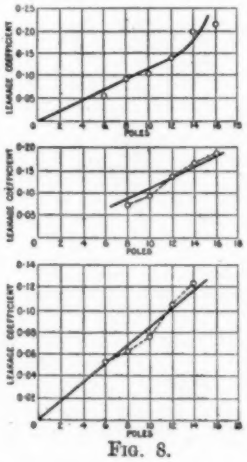



FIG. 8.

be connected to any outside circuit, and if these terminals are short-circuited the winding is also internally short-circuited. Hence, the secondary currents do not pass through the slip-rings at all.

The leakage coefficient of these machines is practically proportional to the number of poles, and fig. 8 illustrates this feature. Such curves will be of considerable interest to designers, and could not be obtained from any other type of motor except one retaining an absolutely identical winding on all numbers of poles.

*Cascade Motors.*—A second line of progress leads in the direction of the internal cascade machine. By combining the cascade method with the pole-changing method previously described, machines may be built for three or more speeds. To do this the primary winding is adapted for several numbers of poles, which may be done in a variety of ways. Thus we have an apparatus preserving the unique characteristic of the cascade machine, *viz.*, that of permitting a gradual regulation between speeds, and yet having more than two speeds.

In addition to its usefulness as a multi-speed machine, the cascade induction motor has a wide field of utility in other directions. It may be started with a powerful torque and brought up to its cascade speed by merely cutting out a resistance connected across the tappings on the stator winding. Such a machine will have a completely short-circuited rotor without external connections, and it realises the old desideratum of a squirrel-cage motor with slip-ring characteristics.

Another application, which may possibly prove to be the most important of all, is as a synchronous machine for the purpose of improving the power factor. Such a machine has marked advantages over any other form of synchronous apparatus. The chief drawback to synchronous sets for improving power factor has up to now been their high cost, which is largely due to the amount of auxiliary apparatus they require, in addition to the large number of exciting ampere-turns necessary to give an adequate overload capacity. Both these features are very much reduced in the synchronous cascade set.

This shows itself in practice in the very much reduced size of exciter required by a cascade synchronous motor as compared with the older type. This characteristic renders the synchronous cascade motor feasible from the point of view of cost in much smaller sizes than any other type of synchronous machine.

*Summary.*—(1) A large variety of speed combinations is available, giving any number of speeds up to five (or six with a panel-type controller), all of which are capable of control by simple types of drum controller, and some are capable of being built economically down to 2 or 3 h.p.

These have, for the most part, the characteristics of machines with short-circuited secondaries, but are capable of starting at full-load torque with not more than twice full-load current, and the rate of acceleration in changing speed under full load is under exact control by simple means.

(2) A slip-ring type of motor capable of any number of speeds up to six and capable of accelerating under, say, 2/2½ times the full-load torque from standstill to any of such speeds.

(3) The two-speed cascade motor capable of accelerating from standstill to its lowest speed under 2/2½ times full-load torque by resistance control, and then rising from its lower to its higher speed by short-circuiting a resistance connected across the slip-rings. These two speeds may have practically any desired ratio. Speed-change is effected without opening the stator circuit.

(4) A multi-speed cascade machine capable of starting and accelerating to its lowest speed in the manner just described and then of rising from that speed to any one of its other speeds on short-circuiting the slip-rings.

It is possible to meet practically every condition of variable-speed working required in industrial practice by an appropriate method of control applied to the ordinary induction motor, this control involving no continuous waste of power or other undesirable features, and consisting merely of simple and well-known types of switchgear and, in some cases, small transformers.

For the few remaining cases in which an absolutely gradual speed-variation is required without loss of power we have the polyphase commutator motor, with movable brushes.

I should have no difficulty whatever in recommending a suitable variable-speed alternating-current motor to meet the conditions of any industrial problem whatever, and no cases remain in which it is either necessary or desirable to convert to direct current for the sake of obtaining variable-speed operation.

### Discussion in London.

MR. L. J. HUNT opened the discussion by summarising the theory of windings, and remarked that the development revealed by the lecturer was remarkable. His phase transformer was a beautiful device, and it was strange that they who had worked on the theory and design of windings so long had failed to appreciate the possibilities that the lecturer had taken advantage of. After referring to Dr. F. T. Chapman's recent paper on "The Production of Noise and Vibration by Certain Squirrel-cage Induction Motors," and the advantages of change-pole motors, the speaker exhibited power factor and efficiency curves of two and three-speed machines.

PROF. S. PARKER SMITH referred to the fundamental principles on which the lecturer's machines were based, and though his achievement no mean one; he had given them what they very much wanted, and had showed them how to avoid changing from a.c. to d.c when speed control was needed. In addition to other advantages, Creedy motors would give full-load torque at twice full-load current, conditions which ought not to be objected to by electricity supply authorities. He exhibited lantern slides to illustrate the phase changer and Creedy motor from a different point of view to the lecturer's, and was of the opinion that the machines described in the paper would oust many forms of variable-speed arrangements. Would they also supersede large reversible sets, such as the Ilgner?

MR. H. JACK compared the Creedy machines with the older types of multi-speed motors, and thought that they would still have difficulty in meeting all the requirements for a.c. variable-speed machines. The whole problem was complicated, and the speed limit still existed. The demand for a.c. shunt commutator motors was increasing, and such types were as good as, if not better than, d.c. shunt machines. After so much experience with d.c. commutation they would not be troubled with a.c. commutators which did not have to carry the whole of the current. Such a machine would fulfil the conditions far better than any non-commutating type would.

MR. F. CREEDY briefly replied to the various points raised during the discussion. He exhibited and demonstrated the operation of several motors as well as the drum and panel types of control apparatus.

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**Dutch Glow Lamps.**—The managers of the Philips' Glow Lamp Works Co. announce that they have decided to offer an interchange of shares with the Volt Metal Wire Lamp Co.

# NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

*Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.*

### An Electric Sifter for Foundry Use.

Antiquated, inefficient means of foundry operation are no longer the rule but rather the exception. This is emphasised by the introduction of a new electric sand sifter representing a forward step in foundry practice. This device (fig. 1) can sift a ton of moist moulding sand in four minutes delivering the sand perfectly cleaned and thoroughly mixed. The light weight of the sifter permits it to be hung from any convenient support at any desired height, and every moulder can easily move it over his sand pile or sift directly over core trays or flasks. The greatest vibration of this sifter is claimed to be only 5/16 in. from its vertical position. The capacity of the sifter appears to be a direct result of the electric motor, which is connected direct to the riddle. It is a vertical G.E. motor, in which the armature and shaft remain reactionary and the field and housing revolve at high speed, the housing being weighted on one side by an extremely rapid and regular vibratory motion similar to that of an eccentric fly-wheel.

Because of the direct connection of motor to riddle, a minimum of power is required since no power is lost through transmission or friction and because the motor is completely equipped with specially-designed ball-bearings of the self-

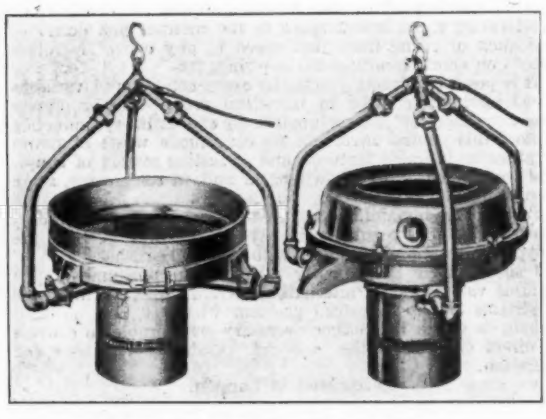

FIG. 1.—AN ELECTRIC SAND SIFTER.

oiling type. This motor is enclosed in a dust- and grit-proof casing, and cooling air is circulated around the motor by its own peculiar motion. The air is drawn in at the top of one arm of the supporting frame tubing, and after circulating around the motor is expelled at the top of another arm. A valve trap at the air intake prevents dust and dirt entering the motor.—*Railway Review.*

### The Runbaken Petrol Gauge.

An efficient device for indicating the amount of petrol in an automobile tank is made by the RUNBAKEN MAGNETO CO., LTD., Derby Street, Manchester. This gauge, which is shown in section in fig. 2, consists of a metallic diaphragm which is moved by the pressure of the petrol in the tank. In the centre of this is a pin, which moves a small spring-retracted

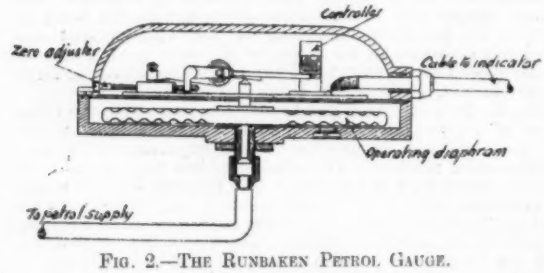


FIG. 2.—THE RUNBAKEN PETROL GAUGE.

arm over a commutator connected to the battery, from the segments of which connections are made to windings on an indicating instrument. In this instrument a magnet needle is deflected by the rotating field set up by the windings. The current consumption is practically negligible, and the instrument is totally unaffected by vibration and voltage variations.

### Pilot Lamp for Electric Irons.

Mr. J. F. L. CORBETT, B.Sc., of 34, Woodcote Road, Wallington, Surrey, points out the suitability of the 5-watt "Osglim" lamp as a pilot lamp for use with electric irons, and other non-luminous heating devices, to indicate that they are on circuit. In place of the usual lamp-holder, a switch-holder is fitted and a "Prangnell" adapter connected to this. The iron is connected to the lower holder of the adapter, and in the upper holder a 5-watt "Osglim" lamp is placed. The sketch, fig. 3, shows the arrangement which has been used successfully for months, the extra security warranting the slight extra expense.

### A Food and Drink Mixer.

The SUN ELECTRICAL CO., LTD., 118 & 120, Charing Cross Road, W.C.2, have placed on the market a simple motor-driven

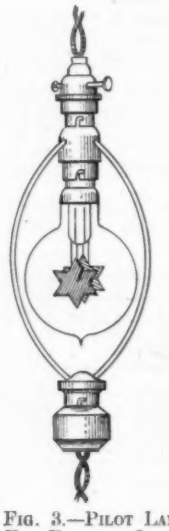

FIG. 3.—PILOT LAMP FOR ELECTRIC IRONS.

FIG. 4.—A FOOD AND DRINK MIXER.

apparatus for the mixing of food and drink (fig. 4). This device, which bears the lengthy title of "Air-o-Mix Whip All" consists of a two-speed electric motor driving a spindle at the bottom of which are two air tubes which aerate the substance being treated. It is claimed that this facilitates digestion and makes such things as cakes, &c., much lighter.

### A Cut-out Fixture Device.

A cut-out and lowering device (fig. 5), by means of which cleaning of electric light fixtures and lamp replacement can be

FIG. 5.—A CUT-OUT FIXTURE DEVICE.

done in absolute safety is being manufactured by the Westinghouse Electric & Manufacturing Co.

The device, which is called a pulley socket, is so arranged that a pull on a rope disconnects the electrical parts and the entire fixture is lowered from the ceiling. The disconnection can be made without first switching off the circuit, for within the pulley socket wiping contacts are provided of sufficient capacity to make and break the current of a 1,000-W lamp. A second pull resets the fixture in place. An angle reflector can be used, for the device is so designed that the reflector will always come back into its true position and lock into place. All the parts of this pulley socket are built in liberal dimensions and are totally enclosed in a cast-iron housing. The socket is provided with a double lamp grip under which the lamp is held so that it cannot loosen from vibration.

Some of the advantages of the use of this pulley socket are that it saves time in cleaning, eliminates the dangerous use of ladders, makes possible a more thorough cleaning of fixtures with less effort, and eliminates the danger of short circuits and accidental contact with live parts.—*National Electragist* (U.S.A.).

### The "Waste-Not" Paint Pot.

MESSRS. GRIFFITHS BROS. & Co. (LONDON), LTD., Macks Road, Bermondsey, S.E.16, have sent us one of their "Waste-Not" paint or varnish pots, which, as the name implies, are designed to ensure economy. These have the shape of the ordinary paint pot, but are provided with a double top. The principal lid is a "push" fit into the body, and in the centre of this lid is an elliptical opening with a raised collar. The brush, which is provided with the pot, has a hood of the same shape, and this fits over the collar, rendering the pot almost air-tight. Thus, by the replacement of the brush, the pot is automatically closed, and waste by evaporation or spoiling by the absorption of dust and moisture is avoided.

## EAST-MIDLANDS ELECTRICITY DISTRICT.

AMENDED CONFERENCE SCHEME.

IT will be recalled that the above-named electricity district was delimited by the Electricity Commissioners two years ago*, and that the East Midlands Conference of Local Authorities (Nottingham) submitted a scheme for improving the supply of electricity in the area 12 months since.† The scheme, however, has been amended (and in connection therewith the Electricity Commissioners are to hold an inquiry at Nottingham on January 23rd) to provide for the establishment of the East Midlands Electricity Advisory Committee the members of which shall be appointed, it is proposed, as follows:—

By local authorities (15): The cities of Leicester (three members) and Nottingham (three); the county boroughs of Derby (three) and Burton-on-Trent (two); the boroughs of Loughborough (one), Mansfield (one), and Newark (one); and the urban district council of Long Eaton (one).

By companies (five members jointly): The Derbyshire and Nottinghamshire Electric Power Co. (three) and the Leicestershire and Warwickshire Electric Power Co. (two).

By county councils (three): Derbyshire (one), Leicestershire (one), and Nottinghamshire (one).

Railway groups (two) shall jointly be entitled to appoint one member for each group of the Committee as follows:—Members of the Committee representing railway groups shall be elected by the groups which may use electricity within the district and in default of agreement as to the persons to be elected an election shall be held, in which each railway group shall be entitled to nominate not exceeding two candidates and to record one vote for every 200,000 kWh purchased by such railway group in the district in the year ending December 31st preceding the date of the election.

Large consumers, other than the railway groups and the companies entitled to take part in the election of representatives on the Committee, shall be entitled to appoint two members of the Committee. A large consumer shall be deemed to be a person, firm, or company whose consumption of electricity purchased from the authorised undertakers in the district exceeded 200,000 kWh during the year ending December 31st preceding the date of the election.

The total number of members of the Committee shall be 27.

The main outlines of the technical scheme are: For generation the standard type shall be three-phase a.c., and the standard frequency 50 cycles per second.

For transmission the standard pressure (between phases) shall be, in the case of main transmission lines, 33,000 volts, and in the case of secondary transmission lines 11,000 volts and 6,600 volts as at present. The main transmission lines would be partly overhead on steel towers and poles and partly lead-covered, paper-insulated cables, armoured and laid direct in the ground. Their construction would be gradual, and dependent upon the development of the load and the economic advisability of substituting bulk supply for local generation. The secondary mains for distributing at 11,000 volts and 6,600 volts would also be partly overhead on poles and partly underground cables, similarly to those used for the 33,000-volt transmission. The transformers and switchgear in connection with the main transmission lines would be accommodated, as far as possible, in existing power stations; new sub-stations would be built in other districts as required.

The generating stations, existing or under construction, at Nottingham (North Wilford), Leicester (central generating station), Derby, Burton, and Spondon will continue to be utilised under the scheme, and a new station will possibly be erected at Newark.

Nothing in the technical scheme shall constitute the Committee a Joint Electricity Authority or authorise the Committee to construct or acquire any generating station, main transmission lines, or other works, or to supply electrical energy, and nothing in it shall relieve any authorised undertaker in the district from the necessity of obtaining such consents or approvals under the Electricity (Supply) Acts, 1882 to 1922, as would have been required if the Order giving effect to the scheme had been in force at the passing of the Electricity (Supply) Act, 1919.

The Committee shall within a period of two years from the commencement of the Order giving effect to the scheme, or within such extended time as may be approved by the Commissioners, submit to the Commissioners proposals for securing the supply of electricity in any area within the district (not forming part of the area of supply of any authorised distributors) in which there is a demand for a supply of electricity and a reasonable prospect of such supply being remunerative.

The Committee may appoint an Engineering Advisory Sub-Committee, the members of which shall represent both local authorities and companies.

Every local authority, company, or person proposing to (*a*) extend or alter the plant capacity of a generating station; (*b*) construct a new generating station; or (*c*) extend or alter main transmission lines shall, before proceeding therewith, submit to the Committee details, plans, and estimates of the cost thereof. The Committee or its agents may enter upon and inspect the generating stations and main transmission lines of any authorised undertakers in the district. The Committee may investigate and make recommendations upon (*a*) the adjustment of the running hours of the generating stations in such a manner as to effect the maximum economy in the production of electricity; (*b*) the principles which should govern the charges to be made for reciprocal, stand-by, and bulk supplies.

A constituent authority shall have a right of appeal to the Commissioners in respect of any recommendation of the Committee. Subject and without prejudice to the powers conferred on the Commissioners by Section 19 of the Electricity (Supply) Act, 1919, no such recommendation or decision shall oblige any constituent authority without its consent—(*a*) to raise or borrow any money or incur any expenditure or liability on capital account; (*b*) to take a supply of electricity except at a cost lower than that at which such authority could generate it; (*c*) to give a supply of electricity at a price less than or equal to the cost thereof to such authority.

The Committee shall at the beginning of each financial year estimate its expenses during the year, submit the estimate for approval to the Commissioners, and apportion the amount of the estimated expenses so approved amongst the constituent authorities respectively in the manner following:—(*a*) Each county council, five guineas. (*b*) Each railway group, 20 guineas. (*c*) Each representative of large consumers elected on the Committee shall pay an annual sum of 10 guineas. (*d*) The balance shall be borne by the authorised undertakers in the same proportion as the ratio of kWh sold within the district by them respectively to the total number of kWh sold within the district by all the authorised undertakers in their financial year preceding the year of estimate.

The Derbyshire and Nottinghamshire Electric Power Co. shall not supply or offer to supply directly or indirectly any electricity within or for use within such portions of the existing area of supply of the borough of Derby as were added by the Derby Corporation Electric Lighting (Extension) Order, 1910, confirmed by the Electric Lighting Orders Confirmation (No. 1) Act, 1910, and the Derby Corporation Electric Lighting (Extension) Order, 1913, confirmed by the Electric Lighting Orders Confirmation (No. 2) Act, 1913, except with the consent of the borough.

* ELEC. REV., Nov. 5th, 1920; p. 591.
† ELEC. REV., Dec. 9th, 1921; p. 777.

**Electrically-Driven American Ferryboats.**—Municipal ferryboats under construction at New York are to be electrically driven, according to a statement issued by the General Electric Co., which says, in part:—

The three New York ferryboats being built by the Staten Island Shipbuilding Co. will each be propelled by an eight-stage, condensing, Curtis marine-type turbine.

Each ferryboat will be equipped with one General Electric turbine-driven, alternating-current generator that will, in turn, drive two marine type two-speed induction motors having double squirrel cage rotors.

The high-speed winding will deliver 2,100 shaft horse power at 176 r.p.m., and the low-speed winding will deliver 100 shaft horse power at approximately 122 r.p.m. The ship may be manœuvred either ahead or astern.—*Reuter's Trade Service* (New York).

## NEW PATENTS APPLIED FOR, 1922.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEXTON-JONES, O'DELL AND STEPHENS, Patent Agents, 285, High Holborn, London, W.C. 1.

35,136. "Means for charging accumulators from alternating current." L. B. Turner. December 27th.

35,143. "Electric impulse clocks." A. E. J. Ball and I. H. Parsons. December 27th.

35,150. "Sparking plug." J. Darroch. December 27th.

35,155. "Sensitive elements of relays." Barr & Stroud, Ltd., and J. W. French. December 27th.

35,162. "Wireless telephone installations." T. M. Dalziel. December 27th.

35,179. "Devices for making and breaking electric circuits." T. Zweigbergk. December 27th.

35,189. "Electric-motor starters." Igranic Electric Co., Ltd., and G. H. Pickering. December 27th.

35,182. "Electric condensers." W. Dornig. December 27th.

35,189. "Telephone repeater circuits." General Electric Co., Ltd., and G. C. Marris. December 27th.

35,190. "Lighting devices operated by high-frequency currents." General Electric Co., Ltd. (Patent Treuhand Ges. für Elektrische Gluhlampen). December 27th.

35,191. "Electric switching apparatus." British Thomson-Houston Co., Ltd. December 27th. (United States, December 27th, 1921.)

35,192. "Illuminating devices." British Thomson-Houston Co., Ltd., W. Millner, and H. C. Wheat. December 27th.

35,202. "Electrolytic method and siphon." E. C. R. Marks (Locomotive Firebox Co.). December 27th.

35,208. "Thermionic valves." A. A. W. Barron, C. B. Mitcalfe-Dale, and A. J. Packham. December 27th.

35,219. "In-put circuits of multiple-electrode tubes." Tingey Wireless, Ltd., and W. R. H. Tingey. December 27th.

35,222. "Impulse-transmitters for telephones." Automatic Telephone Manufacturing Co., Ltd. December 27th. (United States, December 29th, 1921.)

35,223. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. December 27th. (Germany, December 24th, 1921.)

35,224. "Calling devices for automatic telephone systems." Automatic Telephone Manufacturing Co., Ltd. December 27th. (United States, December 30th, 1921.)

35,249. "Electrical signalling systems." Western Electric Co., Ltd. (Western Electric Co. Inc.). December 28th.

35,263. "Electric transformers." G. A. Morley. December 28th.

35,264. "Wireless inductance coils." G. A. Morley. December 28th.

35,298. "Inductance coils." A. H. Curtis and Igranic Electric Co., Ltd. December 28th.

35,300. "Heat-resisting stand for electric irons, &c." Cape Asbestos Co., Ltd., and W. A. Godfrey. December 28th.

35,329. "Electric fire-alarm systems." A. L. W. Williams. December 28th.

35,337. "Feeding electric furnaces with current." L. Quattrino. December 28th. (Italy, December 29th, 1921.)

35,343. "Apparatus for collecting and transmitting current from overhead conductor lines." O. Kurz. December 28th. (Austria, March 7th, 1921.)

35,344. "Overhead supply systems for electric traction." O. Kurz. December 28th. (Austria, March 7th, 1921.)

35,345. "Electric conductors." O. Kurz. December 28th. (Austria, March 7th, 1921.)

35,346. "Bank contacts for switches used in telephone systems." Siemens and Halske Akt. Ges. December 28th. (Germany, January 6th.)

35,350. "Carbon resistances." E. H. Weston. December 29th.

35,370. "Reflecting lamp for head-lights." J. T. Morrison. December 29th.

35,372. "Sparking plugs." A. Crowther. December 29th.

35,375. "Electric resistances." E. J. Halling. December 29th.

35,376. "Electric resistances." E. J. Halling. December 29th.

35,378. "Valve-holders for wireless telegraph apparatus." J. H. Dickson. December 29th.

35,396. "Electric circuits." A. E. McKechnie. December 29th.

35,399. "Wireless apparatus." B. G. Calver. December 29th.

35,403. "Electric telegraph systems." H. V. Higgitt and F. E. Pernot. December 29th.

35,409. "Incandescent electric lamps." C. H. Bingham. December 29th.

35,424. "Automatic make and break device for electric circuits." N. M. Price, S. R. Witts, and W. J. Witts. December 29th.

35,432. "Time switches." C. M. Brown. December 29th.

35,436. "Electric switches." British Thomson-Houston Co., Ltd. December 29th. (United States, April 10th.)

35,437. "Systems of control for dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). December 29th.

35,440. "Induced-current medical instrument." K. Murakoshi. December 29th.

35,442. "Mercury-vapour rectifiers." Akt. Ges. Brown, Boveri et Cie. December 29th. (Germany, January 19th.)

35,448. "Light-projecting apparatus for stages." E. Booth and N. R. Booth. December 30th.

35,457. "Converting or transforming electric currents." W. S. Stephenson and G. W. Walton. December 30th.

35,460. "Thermionic valves." E. Booth and N. R. Booth. December 30th.

35,461. "Incandescent electric lamps." E. Booth and N. R. Booth. December 30th.

35,462. "Manufacture of cores for mercurial cut-outs." W. H. Illingworth. December 30th.

35,464. "Terminals, &c., for electric conductors." Brolt, Ltd., and W. Holt. December 30th.

35,485. "Motor-car head-lamps." H. Workman. December 30th.

35,489. "Insulators for high-tension transmission cables, &c." Bullers, Ltd., and H. S. Newman. December 30th.

35,490. "Wireless masts, &c." S. P. Wing. December 30th.

35,492. "Ignition apparatus for internal-combustion engines." E. H. Mills, W. F. Possee, and H. F. Yeowell. December 30th.

35,493. "Electric ignition devices." British Thomson-Houston Co., Ltd., E. G. Parrott, and A. P. Young. December 30th.

35,496. "Electric circuit-breakers." D. R. Davies, and Metropolitan-Vickers Electrical Co., Ltd. December 30th.

35,498. "Mine signal apparatus." W. B. Dale, R. A. Hopkinson, and J. Hopkinson & Co., Ltd. December 30th.

35,504. "Dynamo-electric machines." Sir C. A. Parsons and J. Rosen. December 30th.

## PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

### 1921.

16,531. "Electron discharge devices." British Thomson-Houston Co., Ltd. (General Electric Co.). June 15th, 1921. (190,184.)

21,749. "Fluorescent screens." British Thomson-Houston Co., Ltd. (General Electric Co.). August 16th, 1921. (190,201.)

23,895. "Electrical transmission systems." A. M. Taylor. September 7th, 1921. (190,209.)

24,064. "Electric clock and time signal installations." Schweizerische Magneta Akt. Ges. September 11th, 1920. (168,911.)

24,101. "Process for the continuous leaching of ores, metallurgical products, and other materials on the counter-current principle." A. L. Mond (Metallbank und Metallurgische Ges. Akt. Ges.). September 10th, 1921. (190,212.)

24,110. "Ignition testing means." A. H. S. MacCullum. September 10th, 1921. (Cognate application, 17,010/22.) (190,214.)

24,207. "Photo-electric devices and methods of manufacturing the same." British Thomson-Houston Co., Ltd. (General Electric Co.). September 12th, 1921. (190,218.)

24,240. "Electric furnaces." L. J. Hancock and T. R. Hancock. September 12th, 1921. (190,222.)

24,251. "Manufacture of electrolytes for galvanic elements." R. Pörscke. September 12th, 1921. (190,226.)

24,332. "Collectors for electric traction systems." A. J. Hall, R. Brooks, and Metropolitan-Vickers Electrical Co., Ltd. September 13th, 1921. (190,227.)

24,468. "Apparatus for converting electric currents." M. de Coninck. September 30th, 1920. (169,694.)

24,635. "Water-supply connections to electric water-heaters." O. Grünthal and F. H. Zechauer Metall-Warenfabrik. September 16th, 1921. (190,244.)

24,848. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. September 22nd, 1920. (169,443.)

25,187. "Radio-receiving systems." R. H. Marriott. September 22nd, 1920. (169,456.)

25,217. "Electric fuse boards or distribution boards." J. E. Gaffney and J. H. Tucker & Co., Ltd. September 23rd, 1921. (190,259.)

25,257. "Electric control systems." British Thomson-Houston Co., Ltd. (General Electric Co.). September 23rd, 1921. (190,260.)

25,282. "Storage battery plates." Chloride Electrical Storage Co., Ltd. (B. Ford). September 23rd, 1921. (190,262.)

26,322. "Wireless-signalling receiving systems." British Thomson-Houston Co., Ltd. (General Electric Co.). October 5th, 1921. (190,280.)

26,768. "Electric connections or couplings." G Oldham and J. Oldham. October 10th, 1921. (190,289.)

27,324. "Electric cut-out apparatus." C. L. Dubois and C. Reynold. October 14th, 1920. (170,305.)

27,668. "Method of and apparatus for utilising intermittent physical manifestations, such as sound or light waves, to close a relay in a work circuit." British Thomson-Houston Co., Ltd. (General Electric Co.). October 18th, 1921. (190,305.)

28,017. "Apparatus operable at high voltages in an enclosed tank." British Thomson-Houston Co., Ltd. (General Electric Co.). October 21st, 1921. (190,306.)

28,884. "Respirator mouthpieces and telephone transmitters." J. Kelly. October 31st, 1921. (190,316.)

30,630. "Meters for telephone systems." Siemens & Halske Akt. Ges. November 26th, 1920. (172,000.)

31,043. "Electric ignition timers or distributors for internal-combustion engines." V. Shearer. November 21st, 1921. (190,337.)

31,511. "Selective electric signalling systems." Western Electric Co., Ltd. (Western Electric Co. Inc.). November 24th, 1921. (190,344.)

31,730. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). November 26th, 1921. (190,346.)

### 1922.

654. "Electrical transformers." Western Electric Co., Ltd. (Western Electric Co. Inc.). January 9th, 1922. (190,378.)

2,712. "Ignition starting devices for ignition magnetos." V. Boscato. January 30th, 1922. (190,385.)

4,384. "Electrodes for use in heating liquids." O. Meyer-Keller & Cie. June 9th, 1921. (181,324.)

11,813. "Electric head lamps for motor-cars and other like lamps." W. E. Marshall and P. G. P. McCulloch. April 27th, 1922. (190,408.)

17,161. "Manufacture of metal filaments for electric incandescent lamps." General Electric Co., Ltd. July 13th, 1921. (183,118.)

26,157. "Control of trains." A. R. Angus. June 20th, 1921. (Divided application on 16,909/21.) (190,425.)

27,681. "Control of trains." A. R. Angus. June 20th, 1921. (Divided application on 16,909/21.) (190,426.)

**National Association of Radio Manufacturers.**—An Association has recently been formed under the above title. The association, it is claimed, is not a "ring," and does not attempt to control the selling prices of the instruments marketed by its members. Its main objects are "to establish at the outset such fair and equitable conditions of trading as are essential to the well-being of a new industry, and to take up any questions of common interest to the trade upon which united action appears to be desirable." The conditions of membership are simple: An applicant must be a *bona-fide* British manufacturer of radio apparatus and must be eligible for membership of the British Broadcasting Co.

The radio section of the *Daily Mail* Ideal Home Exhibition, to be held at Olympia from March 1st to 24th (inclusive) will be under the control of the Association, and the allotment of space will be made by means of a ballot conducted by the Association. The arrangements include the acquisition of a theatre at Olympia capable of seating 1,000 people, in which radio demonstrations will be organised by the Association throughout the period of the exhibition. The actual booking of space must be arranged direct with the *Daily Mail* authorities, at 130, Fleet Street, E.C. 4. Messrs. Derbyshire & Co., chartered accountants, of 4, Southampton Row, London, W.C.1, are acting as secretaries to the newly-formed organisation.